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A unique reference tool for program managers and related functional or staff managers. The document is in the form of a three-ring notebook containing a series of fact sheets on the fundamentals of nearly all major facets of the program management business with references for sources of more detailed information on each subject. Recipients are provided with updated and new fact sheets as they become available.

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INTRODUCTION

The Program Manager's Notebook is designed to provide system acquisition participants, particularly program managers[1], with a ready reference document which contains basic information and a reference list on selected subject areas of interest or concern to them. The fact sheets, approximately six pages in length, are designed to provide:

- Ready reference to quickly brush up on a topic without searching through lengthy reports, studies or articles;
- Essential summarized guidance for performance of functions or preparation of documents in the selected subject areas;
- Succinct summations of DOD and, if appropriate, service philosophy and policy regarding acquisition subject areas.

This guide will assist program managers as they perform the functions and prepare the documents associated with the systems acquisition cycle. The notebook does not attempt to provide guidance for accomplishment of service-unique functions or preparation of service-directed documents. It is not all inclusive. In those instances where DOD references/examples are insufficient to provide a suitable model, a single service's references/examples are used to construct one.

The Program Manager's Notebook was initially published in October 1985. This edition represents a major update. In addition, the new index lists topics by functional discipline for easier use.

The subject areas were recommended by past, present and potential program managers; acquisition managers representing all of the services; and members of the staff and faculty of DSMC. We request your views to expand and improve the content and format of the notebook. Please use the tear-out sheets provided in the notebook to give us your comments and to provide us with sources for future updates.

Lynn H. Stevens

LYNN H. STEVENS
Major General, USA
Commandant

[1]For brevity, the term "program manager" is used for "program," "project," or "product manager" as well as for other variants.

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NUMERICAL INDEX

INSERT TAB 1

ACQUISITION MANAGEMENT

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

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I. TITLE

Phases in a Major Weapon System Acquisition Life Cycle

II. REFERENCES

—OMB Circular A-109, "Major System Acquisition"
—DOD Directive 5000.1, "Major and Non-Major Defense Acquisition Programs," 1 September 1987
—DOD Instruction 5000.2, "Defense Acquisition Program Procedures," 1 September 1987
—AFR 800-2 "Acquisition Program Management"
—AR 70-1 "Systems Acquisition Policy and Procedures"
—SECNAVINST 5000.1B "System Acquisition"

III. POINTS OF CONTACT

—Service Acquisition Executives
—Development Commands
—Program Executive Officers

IV. PURPOSE AND SCOPE

This fact sheet describes acquisition life-cycle phases of a major defense acquisition program. It provides an overview of the goals of each phase.

V. PROGRAM INITIATION

Although not a formal phase of the acquisition process, most programs result from combat planning, commonly called mission area analysis. Each military service performs a series of mission areas or tasks to meet national security objectives. Examples are: for the Navy, maintain open sea lanes of communication, power projection ashore; Air Force, strategic offense, strategic defense; Army, close combat heavy, close combat light; U.S. Marine Corps, conduct amphibious operations. Each Service receives planning guidance through a high-level planning document, Defense Guidance. The Services compare their current capabilities with current and future enemy threats against these capabilities and derive deficiencies. They try to meet the deficiencies by changing tactics, doctrine, organization, training or other methods that don't cost money. If these methods fail, a new major system might be required. The user from a Service creates a requirements document called a Statement of Operational Need (SON) (Air Force), Operational Requirement (OR) (Navy), or Operational and Organizational Plan (Army). This need is documented to the Office of the Secretary of Defense (OSD) in a Mission Need Statement. The Mission Need Statement is reviewed by the Service headquarters and submitted to the Office of the Secretary of Defense for the program new start. Once the new major program is approved, it enters the Major Defense Acquisition Program Life Cycle.

NOTE: The DODD 5000.1 defines a Major Defense Acquisition Program as one designated by the Secretary of Defense because of:
—Urgency of need
—Development risk
—Joint funding
—Significant congressional interest
—Total research, development, test and evaluation expenditures of more than $200 million in FY 80 constant dollars or $1 billion expenditure for procurement in FY 80 constant dollars
—Other considerations.

The new program will have two reviews. The Mission Need Statement will be reviewed at Milestone 0 by the Defense Acquisition Board An Acquisition Decision Memorandum signed by the Deputy Secretary of Defense or the Secretary of Defense

to the Service acquisition executive signals the birth of the new program, but only when funding is available. Typically, the Service has already budgeted for the low effort required during the initial phase of the program, or can reprogram money from another source. The Defense Resources Board (DRB) will not address the Service request for funding this specific program unless it is an issue. The DRB approves the Service POM with the new program included. The DRB will issue a Program Decision Memorandum to the Service that approves its POM submit.

VI. CONCEPT EXPLORATION/DEFINITION (CE/D)

At MS O, the program receives permission to proceed into the CE/D phase to explore alternatives to meet the documented mission need. The Service may assign a program manager who will lead a team to analyze concepts to meet the need. Competition and innovation are required during this phase to ensure that all alternative solutions are identified and explored. The program office prepares its first detailed acquisition strategy to support the rest of the program.

The CE/D focuses on exploring any concept that might meet the mission need. There is extensive numerical and computer analysis and modeling to determine the best concepts based upon cost, schedule, performance and other parameters the user and the program manager feel are important. The team then selects the best solution or solutions to be continued into the next phase.

The program office begins to staff itself to perform work in future phases. The program management office (PMO) has few people in this phase, yet, decisions made in CE/D will affect the program for the next several years. The PMO staff will increase as the program progresses. The makeup of the PMO will change character as well, during transition from development to production. Typical changes occur in the engineering, production, logistics and test functional areas.

The program office will develop close liaison with the user and with the intelligence community who will produce the program's System Threat Assessment Report.

Technologies that might contribute to the success of the program will be examined. Technology roadmaps which outline the schedule of development and funding for promising technology programs will be prepared. Plans will be prepared. Examples include source selection, risk management, computer resources life-cycle management, integrated logistic support and test and evaluation master plans. These plans guide the program office and decision-makers with evaluations of risks associated with the program. System security engineering will assist in an analysis of the best way to protect classified components and information used in the system at minimum expense in resources. Communications Security (COMSEC), TEMPEST, Operations Security (OPSEC) and other similar programs will be instituted to protect program related information and minimize the enemy's ability to counter our development efforts with reactive threats.

Contractors are asked to prepare many of the above plans with assistance of the government. Concepts proposed by participating contractors are reviewed and analyzed. Contractors are provided operational scenarios to assist them with the trade-off analysis.

Cost estimating plays an important role throughout the program life cycle. Affordability is addressed from the beginning and is one of the criteria used to compare concepts. Total life-cycle costs and costs of development and procurement are estimated. These estimates are used to create program objective memorandum inputs (this document indicates budget requirement by fiscal year).

Documentation to support the Milestone I decision is prepared: System Concept Paper, Test and Evaluation Master Plan, Competitive Prototyping Strategy, Cost and Operational Effectiveness Analysis, Common Use Alternatives Statement, Independent Cost Estimate, Cooperative Opportunities Document, System Threat Assessment Report, and an Integrated Logistics Support Plan.

A source selection will be held to review the management, technical, logistics, and past performance aspects of the competing contractors and to select the contractors who will continue into the next phase.

The end of the CE/D phase will be signaled by the successful Milestone I review. Concerns at this review are mission area analysis, affordability and life-cycle costs, the feasibility of modifying a current system (Allied or United States) to meet the

need, and operational utility assessment. Typical planning for this review begins a year in advance of the milestone review date.

Several events in the life cycle continue throughout the program and will not be addressed again in this note. Examples are the update of the Test and Evaluation Master Plan. Cooperative Opportunities Document, System Threat Assessment Report, Independent Cost Estimate, Cost and Operational Effectiveness Analysis, continued close interface with the user and reaffirmation of the need. A System Requirement Review will be held. Requests for proposal, statements of work, system specifications and other documentation will be prepared for the next program phase.

VII. CONCEPT DEMONSTRATION AND VALIDATION (CD/V)

In an Acquisition Decision Memorandum through the Under Secretary of Defense for Acquisition, the Secretary of Defense directs the program to proceed to demonstrate the feasibility of the chosen concepts. This phase may be the most critical to a program. The Service must select the best concept to meet the need. Frequently, this decision is based upon limited data derived only from subsystem analysis and design. Information about the total system may not be available. Offsetting this risk is the program manager's ability to enhance competition and plan adequately in all areas.

The program office team must select the most preferred system to meet the need. This selection will be based on trade-off analysis of many parameters, testing at the subsystem level and risk analysis of the program and the system designs. A major issue will be resource availability to complete the acquisition (includes affordability).

Concept Demonstration/Validation Phase activities include subsystem prototype development, development testing, limited operational testing, planning and developing the logistic support system, and updating plans started in CE/D.

The user and intelligence communities will continue to be involved in the program. The user will assist the program office to select concepts of support and use of the system as well as offer opinions and support for the best concept. The intelligence community will update the system threat documentation.

The program office will update the program's funding profile for the Planning, Programming and Budgeting System. System engineering will transform functional requirements into system specifications.

The goal of the Concept Demonstration/Validation Phase is to reduce and quantify risk and to prepare for entry into the Full-Scale Development Phase. Documentation required by DODI 5000.2 is prepared. In addition, consideration and planning is started for preplanned product improvements (P3I), if required.

A System Design Review is held to evaluate the contractor's allocation of requirements to subsystems to meet overall system design (MIL-STD 1521A).

Considerations of Milestone II are: affordability vs. military worth; operational suitability and effectiveness; program risk vs. added military capability; planning for transition from development to production; industrial surge and mobilization capability; program stability; potential common use solutions; prototyping and Concept Demonstration/Validation results; manpower, personnel, training and safety assessments; procurement strategy; plans for integrated logistic support; associated C3I requirements including COMSEC. If Low Rate Initial Production (LRIP) is part of the program's acquisition strategy, it may be approved at this milestone. The LRIP is typically a composite operation. The LRIP may produce test articles for use in operational tests to validate the utility and effectiveness of the weapon system. A goal of the LRIP effort is to ensure that the production line and system are as free of defects as possible, ensuring a smooth transition to full rate production.

VIII. FULL-SCALE DEVELOPMENT (FSD)

The Milestone II decision established the basic FSD goals for the program. The program baseline was documented in the Decision Coordinating Paper (DCP), has been agreed to by the program manager, the program executive officer, the service acquisition executive and the DAE, and is the fundamental document by which the PM directs the program. Concepts of acquisition streamlining and design-to-cost will continue to be emphasized.

Transition to production (DODD 4245.7) will be stressed.

This phase will consume enormous resources as the system is integrated from subsystems to a full-up system. Risk analysis and control will receive close attention. The program manager must plan to manage the risk and reduce it to acceptable levels. Management to baselines ensures thresholds are not breached. Competition may be reduced as some contractors are eliminated. This may force the program manager to use innovation to keep competition. Concepts such as teaming, leader-follower, component breakout, technical data package procurement, etc., may be used but should have been planned for in the acquisition strategy.

The program manager must complete the system design and development to the point that a production decision can be reached at Milestone III. Careful monitoring of the logistics and training portions of the program is required.

In order to pass into the next phase, the program manager must demonstrate that all technical, operational and resource requirements and thresholds have been met. There must be a favorable test report from the Service's independent operational test and evaluation organization which assesses the system's operational suitability and effectiveness. Risk must be reduced to an acceptable level before the program can proceed to the next phase. Low rate initial production tests the contractor's ability to produce the system and to prove out the production line. Systems produced during LRIP can be used for operational tests.

Some key activities that occur in this phase are: execution of low rate initial production; completion of developmental testing; system level operational testing; configuration control; and completion of the system design. Preliminary and critical design reviews (PDR, CDR) and Production Readiness Reviews (PRR) are held; manufacturing considerations come to the forefront. Execution of the production planning done in previous phases is accomplished. Corrections for problems that arise during testing are developed. Preparations for the OSD Milestone III review are completed.

The program office team must demonstrate that: program risks are under control and reduced to the minimum; no thresholds or baselines have been breached; *the transition to production efforts are complete*; the threat is still valid and the program responds to it; the operational test results are satisfactory; and the user still needs the system.

The Milestone III review is held at the OSD level. It addresses: results of the completed operational testing; threat validation; production cost verification; affordability and life-cycle cost; production and deployment schedules; reliability, maintainability and plans for integrated logistics support; independent assessment of producibility; realistic industry surge and mobilization capacity; multiyear procurement authorization; manpower, personnel, training and safety requirements; cost effectiveness or plans for competition or dual sourcing. (Note: If the magnitude of the program is sufficiently large and/or the time between the beginning of low rate initial production and full rate production is significantly long, a program review or *Milestone IIIA* review may be needed to approve LRIP before the Milestone III decision point.

IX. FULL RATE PRODUCTION/DEPLOYMENT

The Secretary of Defense has approved the program to proceed into the next phase. The program manager will procure authorized production quantities, deploy the system, and provide logistical support with contractors and/or government people. The successful transition to production from full-scale development is one of the biggest challenges for a program manager. The success of the move depends largely on the previous planning efforts.

The program manager must now ensure that systems are produced and deployed as rapidly as feasible within the constraints of available resources. Program stability must be maintained in the presence of pressures to reduce the government's deficit by cutting back, stretching out or terminating programs. Follow-on operational testing will be done to confirm the system continues to meet operational effectiveness and suitability requirements.

Key activities common to this phase include the monitoring of the manufacturing process and the contract, product acceptance testing, quality assurance audits and surveillance efforts and accepting contract deliverables from the contractor

by signing the form DD250. The program office will rely heavily on the plant representative offices or contract administration service representatives at the plant to do this monitoring. A good working relationship with these agencies should already be in place.

The user/operators will undergo extensive training on the new weapon system. The core of trained people developed in the full-scale development phase will now train the user force. People trained as operators and maintainers will begin to provide feedback to the program office on deficiencies of the system that may not have shown up during operational testing conducted in full-scale development.

Operational deployment location(s) will be configured to accept the new system. Facilities used to train and repair will be started and completed. Training activities will be established. Deployment teams will be dispatched to the operational locations to assist with any unforeseen problems or complications arising from the deployment effort. The teams will consist of government and contractor engineers configuration control experts, quality assurance people and others.

Strong configuration management control will be exercised and will culminate with completion of the physical configuration audit (PCA) on production items. Product improvements to correct deficiencies discovered during testing, and preplanned product improvements developed during previous phases will be incorporated during this phase. either during the production run or as a retrofit to already deployed systems.

Logistical planning of the program will now be executed. Repairs will be made. Statistics on failure modes and frequencies will be compiled. The adequacy of the quantity and distribution of spare parts will be analyzed. This analysis will be used to determine operational readiness.

Success of the operational deployment will be measured and reviewed later in the program. Success will be determined largely by how well the system meets its initial operational requirements, and if it is supported adequately. Adequacy of support will be determined at Milestone IV.

X. OPERATIONAL SUPPORT PHASE

This generalized phase is not really part of the *acquisition* of a weapon system. Once the system has been operational, most developers have gone on to other projects and all the technical data and knowledge has been transferred to the using or supporting command. The development engineers can be called upon to address specific malfunctions that might not be covered by technical data, but for the most part, the user is on his/her own. There will be two milestones in this phase. The *Logistics Readiness and Support Review* is held 1-2 years after initial deployment to review the adequacy of weapon system support; adequacy of spare parts; to verify the system is operating as advertised, technical data used to repair the system is adequate, etc. The second milestone is the *Major Upgrade or System Replacement Decision*. It is held 5-10 years after the system has been in operation and evaluates whether the system still meets the immediate threat, whether it needs modification to meet the threat, or whether it should be scrapped and a new program started.

A final consideration frequently forgotten in previous phases is *Disposal*. Of what use is the system after it has fulfilled its mission and is no longer necessary to meet the operational readiness of the United States? Answers should be available on where nuclear wastes created by the system are going to be disposed, where used-up hull or fuselage can be stored, what will happen to toxic wastes created.

Not every program follows this exact format. In fact, tailoring is highly encouraged. The degree to which this general acquisition flow is followed depends on factors such as degree of risk, type of program (new, high technology development or non-developmental item program) and the timeframe in which the program is required. The shorter the development cycle allowed, the more concurrency and overlap is required or desired. However, DOD policy as in DODD 5000.1, DODI 5000.2, with guidelines from OMB Circular A-109, requires that DOD acquisition should be done in an efficient and effective manner to achieve the operational objectives of the U.S. Armed Forces.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

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Overview of the Functions of Program Management

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—DOD Directive 5000.1, "Major and Non-Major Defense Acquisition Programs," 1 September 1987
—DOD Instruction 5000.2, "Defense Acquisition Program Procedures," 1 September 1987
—Service Directives, Instructions, and Guides

III. POINTS OF CONTACT

—Your staff
—Other program managers
—Your boss
—Your headquarters staff

IV. PURPOSE AND SCOPE

The purpose of this fact sheet is twofold: (1) to assist the reader to achieve a sense of perspective regarding the functions of program management, and (2) to identify some of the fundamental tools and concepts that are essential to effective program management; i.e., to take a look at both the "forest" and the "trees" from the program manager's perspective. The underlying thesis of this fact sheet is that, despite its political-military industrial environment and despite its complex, state-of-the-art, multibillion dollar products, program management is still, first and foremost, "management." As such, the program manager must understand the generic management functions which, depending on the textbook you use, include some (or all) of the following: planning, organizing, budgeting, staffing, directing, monitoring, and controlling. For program management one additional function should probably be added to the list of generic management functions—maintaining consensus and support.

Successful program management is much more than an exercise in engineering excellence. Program managers must be multitalented individuals, capable of effectively dealing with problems in personnel management, business management, and financial management. They must be excellent communicators. Successful program management requires a broad focus, because failure to perform *any* of the management functions can spell disaster or death for the program.

This fact sheet will highlight the importance of, and the principal tools and concepts associated with, each of the functions of program management.

V. DOD POLICY

The DODD 5000.1 and DODI 5000.2 are first and second in order of precedence for providing policies and procedures and managing major defense acquisition programs, except when statutory requirements override. The policies, principles and objectives of these issuances shall also be applied to non-major defense acquisition programs.

VI. PLANNING

While effective execution of each of the functions of program management is truly essential for success, planning is perhaps the most important of all the functions. This is so because without a well-thought-out plan, a meaningful, supportable budget cannot be developed; without a plan, the office cannot be effectively organized and staffed; without a plan, directing the activity of others is

a random, crisis-oriented, inefficient exercise; without a plan, monitoring and controlling are meaningless; and without a plan, maintaining consensus and support, both internal and external, is left completely to chance. It is only through comprehensive, integrated, sometimes imaginative and innovative planning that the efforts of the diverse members of the program management team can be effectively coordinated and directed, that support and funding can be maintained, and that success can be efficiently achieved.

Planning and the updating and modifying of previously developed plans is a never-ending challenge for the program manager. The types of plans the program manager can expect to become involved with include:

—*Acquisition Strategy*. The comprehensive, integrated strategy that the program will follow. The acquisition strategy provides the overall concept of the program that the acquisition plan and various functional plans must execute. An acquisition strategy is required by various directives including OMB Circular A-109, DODD 5000.1, and by various Service directives. The exact format and content for a written acquisition strategy is defined by each Service, but is not consistent among the Services. Excellent information on the development and evaluation of acquisition strategies can be found in the DSMC *Acquisition Strategy Guide*. Active duty military and government employees may obtain this, supply permitting, by sending a written request to the College Department of Research and Information. Others may obtain it from the U.S. Government Printing Office or the Defense Technical Information Center.

—*Acquisition Plan*. The acquisition plan is a document with its format and content specified in FAR and DFARS Part 207. Unlike the acquisition strategy which covers all aspects of the program, the acquisition plan focuses on the next phase of the program and addresses a single contract or group of contracts for the same, or similar, items within the program. The acquisition plan summarizes the specifics of the technical, schedule, logistics, financial, and business considerations of a particular phase within the program.

—*Functional Plans*. In addition to the acquisition strategy and the acquisition plan, which are integrated, overview-type documents, the program office will develop (or cause to be developed) a variety of functional plans. These functional plans lay out the details of specific segments of the overall effort. Included in this category are: the systems engineering master plan (SEMP), integrated logistics support plan (ILSP), test and evaluation master plan (TEMP), source selection plan (SSP), competition plan, etc. In addition, the program office will review and approve plans the contractor prepares.

—*Schedules*. Scheduling is an important aspect of planning. There must be a master program schedule that shows the important program activities and milestones. The master schedule must be updated constantly to reflect the current status and upcoming events; otherwise, it becomes useless. In addition to the master schedule, functional schedules need to be developed to show the details required to accomplish the various milestones. Various manual and automated techniques are available, ranging from simple charts to sophisticated networks. The degree of sophistication is not as important as the very existence of a master schedule and functional schedules, and the discipline to prepare and update them.

VII. BUDGETING

Once an acquisition strategy has been developed and time-phased in accordance with the master schedule, a budget can be generated. Budgeting is a most important function of management because, clearly, without money there can be no program. Budgeting, as part of the planning, programming, and budgeting system, is a biennial, never-ending process.

Budgeting begins with cost estimating and presents the program manager with a delicate dilemma: if the cost estimate is too high, the program may not be funded because it is not affordable; if the estimate is too low, the seeds are sown for later cost overruns and the resulting criticism and/or cancellation for uncontrollable cost growth. The cost estimate provides the foundation for the budget and establishes a financial benchmark that will be a significant factor in measuring program success.

Once estimates are completed, the necessary budget documentation (which varies among the Services) can be prepared. Following submission

of the budget request, the program manager will begin the process of budget defense. First within his/her command, then within his/her Service, then with OSD/OMB, and, finally, with Congressional Authorization and Appropriation Committees.

The program manager's personal involvement in this process of budget defense will vary from program to program.

Once the budget is finally approved, apportioned, and allocated, a process which frequently takes until well into the new fiscal year, the program manager can, at long last, begin executing the plan. This process from cost estimating through the beginning of the execution phase normally takes from 18 to 24 months or more.

VIII. ORGANIZING AND STAFFING

Money is not the only resource needed by the program manager—people are needed also. Staffing the office with competent, motivated people is of critical importance to the success of the program. Organizing and staffing the office is not only of critical importance, it is also a never-ending challenge to the manager.

Organizing is a less frequent challenge, but the program office organizational structure should be reviewed and changed from time to time as the program progresses through the life cycle. For example, in the early phases, design engineering talent may need to be emphasized. In later phases, production and logistics oriented talent becomes more critical.

Personnel management, including recruiting, training, motivating, rewarding, etc., are literally everyday occurrences, the importance of which cannot be overemphasized.

IX. DIRECTING

In the world of matrix organizations in which most program managers must operate, much of the direction for a program may come from outside the program office. It may come from the engineering directorate, user, logistics directorate, comptroller, contracting officer, lawyer, etc. In the bureaucratic world, much of the direction for a program may come from the boss, procurement review committee, business strategy panel, configuration control board, headquarters staff, secretariat, Defense Acquisition Board (DAB), and even the Congress.

In this environment, the program manager may feel more a coordinator, a balancer of competing and often conflicting forces, than a director in charge of his/her destiny. The program manager and the members of his/her office can do much to influence the direction they receive. Futhermore, as the executors of the program, they can interpret the direction and, to some extent, tailor the guidance to their particular circumstances. The most effective way to influence the direction of others is by staying on top of (or one step ahead of) the emerging problems within the program as well as the emerging changes in administration policies and congressional interests. More on that follows in paragraph X.

In addition to influencing the direction he/she receives, the program manager does, indeed, have directive authority. This directive authority falls into two categories: *internal* to the program office, and *external* to the office. Clearly, the PM has authority to direct the internal operation of his/her office. Much time is spent giving word-of-mouth direction to subordinates on a day-to-day, perhaps hour-by-hour, basis. He/she may write, or have written, internal operating procedures and directives, standard operating procedures, and the like. Less formal memoranda will be used to direct operations of the program manager's office.

The PM will provide direction to organizations outside the program office. Perhaps the most significant external direction provided is through contracts with the contractor. Assisted by a contracting team, the PM has primary responsibility for the content of the contracts that affect the program, as well as changes and modifications to those contracts. In addition, the PM will use other vehicles to direct other government organizations in support of the program. Examples of such vehicles include military interdepartmental purchase requests (MIPRs), project orders and work requests, memoranda of agreement (MOA), and memoranda of understanding (MOU).

X. MONITORING

In the previous section, it was stated that, in addition to a directive authority, the program manager is in a position to influence the direction

received from others by staying on top (or one step ahead) of emerging problems. To do this, he/she must have an effective set of monitoring sensors. These sensors must be able to identify when events are in accordance with the plan and when they are not. Only by having a sensitive, effective early warning system can the program manager hope to exert effective control and truly act in a directive or proactive, rather than a reactive mode. Types of monitoring sensors that may be employed include: program reviews, reports of all kinds, audit (financial and technical), various tests, and a variety of field organizations like DCAS, AFPRO, NAVPRO, ARPRO, and DCAA offices.

While monitoring events surrounding the program, the program manager must be keenly aware that external organizations are monitoring what is going on. Such organizations include the Congress and the GAO, OSD and the DOD Inspector General, his/her Service, and the media.

XI. CONTROLLING

Once the monitoring sensors detect a deviation from the plan, a control mechanism must be activated to bring the system back into line. Much "directing" that the program manager actually performs is in the form of exercising control mechanisms. The program manager's control mechanisms include a variety of provisions contained in the contract with the contractor, such as the changes clause, the use of incentives and award fees, the suspension of progress payments, and, ultimately, the right of termination of the contract. Within his/her office, the program manager must use authority wisely to dispense rewards and punishment as means of controlling the internal affairs. Finally, inside and outside the office, there must be, with or without formal authority, use of powers of persuasion to accomplish objectives.

The program manager must be constantly aware that external organizations have the power to exert control over his/her program. Examples include the Congress with its power to control through the budget authorization and appropriation process and other forms of legislation; OMB, with its influence over the President's Budget; OSD, with its influence through the DAB as well as the budget process; and, of course, his/her Service with finanacial and program approval forms of control over the program.

XII. MAINTAINING CONSENSUS AND SUPPORT

All functions discussed so far, planning, budgeting, organizing, staffing, directing, monitoring, and controlling, are functions common to managers everywhere. This last function, maintaining consensus and support, is not found in textbooks on management. Yet, it is a function that may demand half of the program manager's time and effort. Perhaps it is the importance of this function that separates program management from other forms of management.

Maintaining consensus and support is accomplished by having countless meetings and presenting endless rounds of briefings to people outside the program office. The burden created by this function is so great that some program managers literally designate themselves as "Mr. Outside" and designate their deputies as "Mr. Inside."

In the bureaucratic world of major systems acquisition, with so many people in a position to provide direction and control, conflicting and contradicting direction is an ever-present danger. Loss of consensus can send the program into useless, inefficient oscillations that satisfy no one and frustrate everyone. Loss of support can cause the program to die either a fast or a slow death.

As a balancer, an optimizer of competing goals and direction, the program manager must never forget a program survives only so long as it maintains an acceptable level of consensus and support. Organizations whose support must be maintained include: the program management office and those in the supporting matrix organization, other participating agencies/offices, user, Service headquarters, OSD, OMB, the President, the Congress and staffers, industry, and the public. Maintaining consensus and support is a critically essential, never-ending challenge.

XIII. SUMMARY

The functions of program management are many and varied and encompass all the functions found in managerial positions everywhere, plus the function of maintaining consensus and support. Each function is a challenge in itself and often seems more important than any other. The real challenge of program management is to avoid focusing too heavily on any one of them, but, rather, to devote the appropriate attention, at the appropriate time, to each of them, delegating (without abdicating) where possible.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Policy and Organization Management Department
Number: 1.3
Version: Updated
Date: November 1988

I. TITLE

The Defense Acquisition Board (DAB) Players and Process

II. REFERENCES

—DOD Directive 5000.1, "Major and Non-Major Defense Acquisition Programs," 1 September 1987

—DOD Instruction 5000.2, "Defense Acquisition Program Procedures," 1 September 1987

—DOD Directive 5000.49, "Defense Acquisition Board," 1 September 1987

III. POINTS OF CONTACT

Office of the Secretary of Defense,
Chief, Defense Acquisition Board Operations,
(202) 695-2400; AV 225-2400.

IV. PURPOSE AND SCOPE

This fact sheet is designed to:

—Provide a description of the Department of Defense (DOD) acquisition process.
—Describe the review process and the function of the Defense Acquisition Board (DAB).
—Identify the DAB players and their responsibilities.
—Discuss major DAB concerns and issues.

V. THE DEFENSE ACQUISITION REVIEW PROCESS

Background. In a memo dated 30 May 1969 to the secretaries of the military departments, Deputy Secretary of Defense (DEPSECDEF) David Packard established a group to review major weapon system acquisition. The original body was called the "Defense Systems Acquisition Review Council (DSARC)." In 1986, the group was called the Joint Requirements and Management Board (JRMB) and now is the Defense Acquisition Board (DAB). Policies and procedures for managing DOD acquisitions and for conducting these reviews are contained in DODD 5000.1 and DODI 5000.2.

During the almost 20 years since the initial memo, there have been many revisions to the governing policies and procedures. The composition of the review group has changed frequently. The number of Milestone decisions has varied. Directives have redefined major and non-major systems. Roles and responsibilities of the major participants have been altered continually. The most recent changes occurred in September 1987.

The September 1987 issue of DODD 5000.1 and DODI 5000.2 establishes current policy and procedures for managing Department of Defense (DOD) acquisition. In this version, several significant changes have occurred. First, there is emphasis on the non-major programs as well as the major program. Second, a new position of Program Executive Officer (PEO) was created. Third, the membership in the review body, now called the DAB, has been changed. Fourth, two new milestones were added. Finally, the procedures for reviewing programs have been completely revised. In the following sections of this fact sheet, elements of current policy and procedure are outlined.

Purpose of the DOD Acquisition System. The Department of Defense acquisition system is a single uniform system whereby all equipment, facilities, and services are planned, designed, developed, acquired, maintained, and disposed of within the Department of Defense. The system entails establishing policies and practices that govern

acquisitions, determining and prioritizing resource requirements, directing and controlling the process, contracting and reporting to the Congress. This single system applies to both non-major and major systems acquisitions.

The review process is the way various Department of Defense programs are monitored to ensure compliance with guidance and direction and to ensure system requirements are met. The review group makes recommendations to the decision-maker. This may be either the Secretary of Defense (SECDEF), for major systems, or the appropriate individual within the Services for non-major systems. Recommendations are about program parameters such as cost, schedule, performance, and affordability. In turn, the decision-maker gives the authority to proceed to the next phase or provides other necessary guidance.

These decision points come at specific points in the acquisition life cycle. Currently there are five milestones scheduled at various key times throughout the life of the program. These milestones, identified and described in DODD 5000.1, are:

—Milestone 0. Program Initiation/Mission-Need Decision approval or disapproval of a mission need and entry into the Concept Exploration/Definition Phase.

—Milestone I. Concept Demonstration/Validation Decision approval or disapproval to proceed into the Concept Demonstration/Validation Phase.

—Milestone II. Full-Scale Development Decision approval or disapproval to proceed into the Full-Scale Development Phase and, as appropriate, Low Rate Initial Production.

—Milestone III. Full Rate Production Decision approval or disapproval to proceed into the Full-Rate Production and Initial Deployment phase. Initial deployment also marks the beginning of the Operations Support phase.

—Milestone IV. Logistics Readiness and Support Review encompasses a review 1-2 years after initial deployment to ensure operational readiness and support objectives are achieved and maintained during the first several years of the operations support phase.

—Milestone V. Major Upgrade or System Replacement Decision encompasses a review 5-10 years after initial deployment of a system's current state or operational effectiveness, suitability and readiness to determine if major upgrades are necessary, or if existing deficiencies warrant consideration of replacement action.

Criteria for Major Systems. The Secretary of Defense is authorized by the Office of Management and Budget (OMB) Circular A-109 to designate those programs which are to be managed as major systems acquisitions. The SECDEF may so designate a program because of the urgency of the need, development risk, joint funding, significant congressional interest, or other factors. One of the other factors frequently used is the estimated eventual total expenditures. A program may be designated major if it requires an eventual total expenditure for research, development, test and evaluation of more than $200 million (based on fiscal year 1980 constant dollars); or an eventual total expenditure for procurement of more than $1 billion (based on fiscal year 1980 constant dollars).

A major defense acquisition program will be designated as either a Defense Acquisition Board or Component program. A DAB program requires a SECDEF decision *at each milestone review point*, unless the SECDEF delegates it to the cognizant DOD Component Head. A Component program designation means that the authority to make milestone decisions has been delegated to the cognizant DOD Component Head.

Acquisition Policy. The following policies govern the acquisition of major and non-major acquisition programs:

—*Responsive Support of National Policy and Operational Objectives.* The policy is to ensure timely, efficient and effective system deployment to meet operational needs. This is to be done under the guidelines of OMB Circular A-109.

—*Streamlined Acquisition Organizations.* The DAB programs are to have no more than two management tiers between the program manager (PM) and the defense acquisition executive (DAE). For Component programs, there is to be no more than one management tier between the PM and the Service acquisition executive (SAE).

—*Acquisition Phases and Milestone Decision Points.* The acquisition process is normally divided into five phases to enhance management effec

tiveness. The phases are the periods between milestone decision points and were described above. These phases are to be tailored to fit each acquisition to minimize acquisition time and life-cycle costs. However, the phases and milestone decision points should suit the urgency of need and the degree of technical risk involved.

—*Continuing Analyses of Mission Areas.* The DOD Components are to conduct mission area analyses on a continuing basis. These analyses identify deficiencies and may result in the start of a new acquisition program. Such new starts are justifiable when it is necessary to eliminate an operational deficiency, to establish new capabilities in response to technological advances, to significantly reduce ownership costs, or to respond to a change in national defense policy.

—*Requirements Validation and Alternatives to New Development.* Whenever possible alternatives to a new program start should be sought. Several alternative approaches are:

—Changes in U.S. and Allied strategic or tactical concepts and doctrine

—Use of an existing U.S. or Allied military or commercial system

—Modifying or improving an existing system

—A cooperative research and development program with one or more allied nations.

—*Consideration of Potential Common-Use Solutions.* Whenever possible early in the Concept Exploration/Definition Phase, consider common alternative solutions between weapon systems.

—*Affordability Assessments.* Affordability is a function of cost, priority and availability of fiscal and manpower resources. Affordability shall be considered at every decision milestone and during the Planning, Programming and Budgeting System (PPBS) process.

—*Enhancing Program Stability.* Making excessive changes is ineffective, inefficient, and causes time delays. Thus, program funding and requirements changes shall be minimized and shall not be introduced without considering tne impact on the overall acquisition strategy.

—*Tailored Acquisition Strategy.* A primary goal in developing an acquisition strategy is to minimize the time it takes to satisfy the identified need.

—*Industrial Base Considerations and Government-Industry Relationships.* A strong U.S. industrial base is essential for a strong defense. Accordingly, the near- and long-term implications and ramifications of proposed acquisition programs on the U.S. defense base shall be explicitly considered during the decision-making process.

—*Cooperative Acquisition Efforts.* Cooperative acquisition efforts with U.S. Allies are essential to achieve the highest practicable degree of standardization and interoperability, and avoid duplication of effort.

Procedures. The Defense Acquisition Board is the primary forum used by DOD Components to resolve issues, provide and obtain guidance, and make recommendations to the Secretary of Defense on matters pertaining to the Department of DOD acquisition system. The DAB shall also make recommendations on milestone decisions for DAB programs.

Members of the Defense Acquisition Board are as follows:

—Under Secretary of Defense for Acquisition (USD(A)), Chairman
—Vice Chairman, Joint Chiefs of Staff, Vice Chairman
—Assistant Secretary of Defense Comptroller (ASD(C))
—Assistant Secretary of Defense, Production and Logistics (ASD(P&L))
—Assistant Secretary of Defense, Force Management and Personnel (ASD(FM&P))
—Director, Program Integration
—Director of Defense Research and Engineering (DDR&E)
—Assistant Secretary of Defense, Program Analysis and Evaluation (ASD(PA&E))
—Director, Operational Test and Evaluation (DOT&E)
—All Service Acquisition Executives
—The DAB Committee Chairs, as appropriate.

To assist the DAB in this process, current policy establishes ten DAB acquisition committees. Three are "primary" committees: Strategic Systems Committee, Conventional Systems Committee, and C^3I Committee. Each program will be assigned to one of these committees for OSD level management. The primary committees will review a DAB program

prior to a DAB meeting. The purpose of the committee reviews are to identify and, where possible, reach consensus on issues; determine the issues to be brought before the DAB; and to formulate recommendations for DAB consideration.

The ten Defense Acquisition Board committees are:

—Science and Technology
—Nuclear and Chemical Weapons
—Strategic Systems
—Conventional Systems
—Command, Control, Communications, and Intelligence Systems
—Test and Evaluation
—Production and Logistics
—Installation, Support, and Military Construction
—International Programs
—Policy and Initiatives.

Prior to a DAB, there is much interaction among the OSD staff and the DOD component personnel. This is especially true in the 3 months prior to a DAB. The program manager must prepare documentation in accordance with DODI 5000.2 Then, he must present briefings to the OSD staff who analyze the data and provide feedback. This process ensures a complete dialogue on major issues and should result in a successful DAB.

At the DAB meeting, the executive secretary, with the cognizant committee chair, presents the committee report and unresolved issues are discussed. The DAB members are responsible for participating in these issue discussions and providing any additional, relevant information. Following these presentations, DAB members will develop and present recommended findings to the DAE. The DAE shall present recommendations of the DAB to the SECDEF for decision approval.

The DAB executive secretary will work with the Committee Chairs to coordinate the Acquisition Decision Memorandum (ADM). This is a memorandum to a Component Head signed by the SECDEF. It documents Secretary of Defense decisions. The ADM will include approval of: 1) goals and thresholds for cost, schedule, performance, readiness, and supportability; 2) exceptions to the normal acquisition process; and 3) other appropriate direction.

The timetable used for DAB reviews is shown in Table 1.

Documentation. The program documentation for DAB programs should follow the procedures spelled out in DODI 5000.2. However two documents that need to be highlighted are the Mission Need Statement (MNS) and the Program Baseline.

An MNS document is used when a new major defense acquisition program is required to meet a threat. If the proposed program meets the dollar thresholds ($200M in RDT&E; $1B in Production in FY 80 constant dollars), an MNS is required. All acquisitions compete in the OSD Program Objectives Memorandum (POM) review process on the basis of justifications provided by the DOD Components.

Table 1. TIMETABLE FOR DAB REVIEWS

Milestone Planning Meeting	**4-6 months before DAB**
Draft Documentation	**3 months before DAB**
Comments Back to Service	**2 months before DAB**
Component Briefings	**5 weeks before DAB**
—Action Officer	
—Cost Analysis Improvement Group	
—Operational Test and Evaluation	
—Development Test and Evaluation	
—Production and Logistics	
—Weapon Support Improvement Group	
—Force Management and Personnel	
—Defense Intelligence Agency	
Final Documentation	**3 weeks before DAB**
OSD Staff Prebrief-Committee Action Officer	**3 weeks before DAB**
Committee Review	**2 weeks before DAB**
DAB Read Ahead to DAB (Executive Secretary)	**1 week before DAB**
Signed Acquisition Decision Memorandum (ADM)	**2 weeks after DAB**

The program baseline is a formal agreement between the program manager, the Program Executive Officer (PEO), the Service Acquisition Executive (SAE), and the Defense Acquisition Executive (DAE). The program baseline is documented in the System Concept Paper (SCP) at Milestone I, and in the Decision Coordinating Paper at Milestones II and III. This document briefly summarizes factors critical to the success of a program, such as functional specifications, cost, and schedule and operational objectives and requirements. It is these factors against which the program will be evaluated.

With respect to the program baseline, DODI 5000.2 states that programming and budgeting decisions that invalidate a Milestone decision or other ADM direction, or breach an approved Milestone II or III program baseline shall be immediately highlighted by the DOD Component Heads. Baseline breaches are reported using the Defense Acquisition Executive Summary (DAES) Exception Report (DODI 7220.32). The Component Head shall advise the DAE of the impact on military capability and total acquisition resource requirements. In addition, the DOD Component Head shall explain and justify to the DAE differences in quantity and funding between the program baseline and the program and budget under review.

Players. It is important that the program manager and the program office staff understand the roles of DAB participants, categorized as DAB members, Committee members, advisors and key administrators. The DODD 5000.1 defines the responsibilities of the major DAB participants. The advisors are experts in a specific field. They assist the DAB members and the Committee members. The administrators are responsible for scheduling and conducting the meeting.

According to DODD 5000.1, the following is a summary of the responsibilities of the major DAB Process participants:

—*The Under Secretary of Defense for Acquisition* is the principal staff assistant and acquisition advisor to the SECDEF, serves as the Defense Acquisition Executive and shall:

—Establish uniform acquisition policies and procedures

—Ensure compliance with established policy and procedures

—Chair the DAB.

—*The Head of each DOD Component* cognizant over, and responsible for, acquisition programs shall:

—Appoint an SAE with clear lines of authority, responsibility and accountability

—Establish an acquisition management structure within the Component which is consistent with DODD 5000.1

—Ensure that high quality, experienced personnel are assigned in support of the SAE, PEO and PM. Also see that the tenure is of sufficient length to provide continuity.

—Establish management training and career incentive programs

—Ensure that SECDEF and DAE decisions and guidance are implemented efficiently and effectively

—Ensure that performance appraisal system is consistent with the concept of the streamlined acquisition management structure.

—*The Vice Chairman of the Joint Chiefs of Staff*, as the designee of the Chairman of the Joint Chiefs of Staff (CJCS), shall:

—Serve as Vice Chairman of the DAB

—Provide advice and assistance concerning military requirements and priorities and the feasibility of common-use and/or joint solutions to military service requirements

—Serve as spokesperson for Commanders-in-Chief of the Unified and Specified Commands on acquisition and requirement matters.

—*Service Acquisition Executives* shall:

—Manage in a manner consistent with DODD 5000.1 and DODI 5000.2

—Expeditiously report breaches of SECDEF decisions and approved program baselines

—Establish acquisition policy and procedures for Component programs.

—*Program Executive Officers* shall:

—Provide management direction consistent with SAE guidelines

—Ensure PMs comply with established policy and procedures

—Keep current on program status and ensure breaches are reported promptly

—Recommend changes in personnel assets

—Ensure that PMs are given full authority to manage their programs.

—*Program Managers* shall:

—Manage in accordance with established policies and practices

—Commit to program baseline

—Identify personnel and functional management support shortfalls that adversely affect meeting Secretary of Defense decisions and the approved program baseline

—Report promptly all imminent and actual breaches of SECDEF decisions and approved program baselines

—Prepare and submit timely and accurate program performance reports.

The DAB advisors do not have specific responsibilities. They get involved in their specific areas of expertise as requested by the DAE or the Committee chairmen. The DAB executive secretary is appointed by the DAE and is responsible for maintaining and distributing the list of major programs; arranging meetings; assembling, distributing and maintaining current program documentation; and recording recommendations. The OSD Action Officers are responsible for coordinating OSD issues and DOD component positions; conducting the pre DAB planning meeting and preparing draft ADM.

Some DAB Review Issues. Some typical issues brought up at DABs are:

—Acquisition strategy
—Affordability
—Alternate programs
—Competition/second sourcing
—Cost growth/cost control/cost effectiveness
—Inventory objectives
—Interoperability
—Joint Service requirements
—Need for the System
—Production rates
—Test results
—The Threat
—Threshold breaches
—Transition to production
—Warranties.

VI. SUMMARY

The DAB process is a formal and critical review used to brief the Secretary of Defense on the program's progress, make recommendations, and to receive authorization to proceed to the next acquisition phase. It also gives the OSD and Service staffs an opportunity to come to grips with program problems they have not been able to look at. Further, program managers will have a good idea when they leave the DAB whether they will receive approval to move on to the next phase of acquisition.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Policy and Organization Management Department
Number: 1.3.1
Version: Original
Date: November 1988

I. TITLE

The Defense Acquisition Executive

II. REFERENCES

—DOD 5000.1, "Major and Non-Major Defense Acquisition Programs," 1 September 1987

—DODI 5000.2 Defense Acquisition Program Procedures, 1 September 1987

—DODD 5000.49 Defense Acquisition Board, 1 September 1987

—DODD 5134.1, Under Secretary of Defense (Acquisition), 10 February 1987

—Title 41 (Public Contracts), United States Code, Sections 401-419, "The Office of Federal Procurement Policy Act," as amended

—Title 10 (Armed Services), United States Code, Section 133, "Under Secretary of Defense for Acquisition," as amended

III. POINTS OF CONTACT

Office, Defense Director for Program Integration
Deputy Director Acquisition Systems Mgmt.
Attn: DAB Operations
Room: 1E482
The Pentagon
Washington D.C. 20301
(202) 695-9692; AV 225-9692

IV. PURPOSE AND SCOPE

This fact sheet provides up-to-date information on the position, duties, precedence, and responsibilities of the Defense Acquisition Executive (DAE).

V. POLICY

Title 10 of the United States Code, Section 133, Designates the Under Secretary of Defense for Acquisition (USD(A)) as the Defense Acquisition Executive (DAE). This law also provides that the USD(A) (subject to the authority, direction and control of the Secretary of Defense) has the following duties:

—Supervising Department of Defense (DOD) Acquisition

—Establishing policies for acquisition (including procurement, research and development, logistics developmental testing, and contract administration) for all elements of the DOD

—Establishing policies of the DOD for maintenance of the Defense industrial base

—Is the Senior Procurement Executive for the DOD in accordance with 41 U.S.C. 414(3)

—Shall prescribe policies to ensure that audit and oversight of contractor activities are coordinated and carried out in a manner to prevent duplication by different elements of the DOD.

This law also prescribes the precedence of the USD(A) as follows: With regard to all matters for which he has responsibility by law or by direction of the Secretary of Defense, the USD(A) takes precedence in the DOD after the Secretary of Defense and the Deputy Secretary of Defense. Regarding all other matters the USD(A) takes precedence after the Secretary of Defense the Deputy Secretary of Defense, and the Secretaries of the military departments.

The DODD 5134.1 assigns responsibilities, functions, relationships, and authorities to the USD(A).

In addition to those responsibilities established by law, these include:

—Supervising the entire DOD acquisition system in accordance with DODD 5000.1 and OMB Circular No. A 109.

—Validating acquisition program requirements and developing acquisition program guidance

—Serving as National Armaments Director and Secretary of Defense representative to the Four Power Conference

—Serving as Chair of the Defense Acquisition Board (DAB).

—Ensuring compliance with established acquisition policy and procedures.

The USD(A) fulfills the responsibilities set forth above for the following functional areas:

—Acquisition management

—Basic and applied research, design, engineering, and development of weapon systems

—Acquisition of command, control, communications and intelligence programs and systems

—Logistics management

—Procurement activities

—Scientific and technical information

—Production and manufacturing

—Industrial base resources and productivity

—Force modernization

—Development test and evaluation

—Environmental services

—Assignment and reassignment of research, engineering and acquisition responsibility for programs, systems and activities

—Codevelopment, coproduction, logistics support, and research interchange with friendly and allied nations, in coordination with the Under Secretary of Defense for Policy (USD(P))

—Installation management

—Construction, including construction funded by host nations under the NATO Infrastructure Program.

VI. DISCUSSION

The current DAE/USD(A) structure for managing the DOD acquisition process is a result of the recommendations of the President's Blue Ribbon Commission on Defense Management (Packard Commission) report in 1986 and is still evolving. Program managers should watch future developments as resources become scarcer, and the Congress and the Executive become more involved in what has historically been an agency unique process.

The DAE chairs program and milestone decision reviews for major defense acquisition programs (see DODD 5000.1/DODI 5000.2). Currently, there are provisions for six milestone decision reviews (Milestones 0-V). To assist the DAE in the conduct of milestone reviews and other program reviews, a series of support committees has been established. These committees conduct pre DAB reviews, develop and investigate program issues, and brief remaining issues to the full DAB. A discussion of the committee structure and the DAB process for milestone and program reviews is contained in PM Notebook Fact Sheet 1.3.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department

Number 1.4
Version: Update
Date: December 1988

I. TITLE

"The Systems Approach: Genesis and Perspective"

II. REFERENCES

—Office of Management and Budget (OMB) Circular A-109 "Major System Acquisitions," April 5, 1976

—DOD Directive 5000.1, "Major and Non-Major Defense Acquisition," September 1, 1987

—DOD Instruction 5000.2, "Defense Acquisition Program Procedures," September 1, 1987

—Military Standard 499A, "Engineering Management," May 1, 1974

—*System Engineering Management Guide*, Defense Systems Management College, Second Edition, December 1986

—"The Maturing of the DOD Acquisition Process," *Defense Systems Management Review*, Summer 1980, Vol. 3, No. 3, David D. Acker

—DOD Directive 4245.7, "Transition from Development to Production," February 1, 1985

—*Best Practices for Transitioning from Development to Production Manual*, December 1984, Defense Science Board Task Force

—TRADOC-P 70-2, Headquarters, TRADOC, Fort Monroe, VA 23651 (ATCD-ET)

—*A Guide for Program Management—Acquisition Management*, AFSCP 800-3, April 9, 1976 with revision April 20, 1979, HQ AFSC/SD, Andrews AFB 20334

III. POINTS OF CONTACT

Defense Systems Management College
Fort Belvoir, Va.
SE-T - Technical Management Department
AV 354-3477
SE-P - Policy and Organization Management Department
AV 354-3684
DRI - Department of Research and Information
AV 354-4795

IV. PURPOSE AND SCOPE

—Provide historical perspective for the current policy
—Describe the rationale for the systems approach in Defense System Acquisition program management
—Define terms used in the Department of Defense
—Present DOD System perspective in terms of management principles.

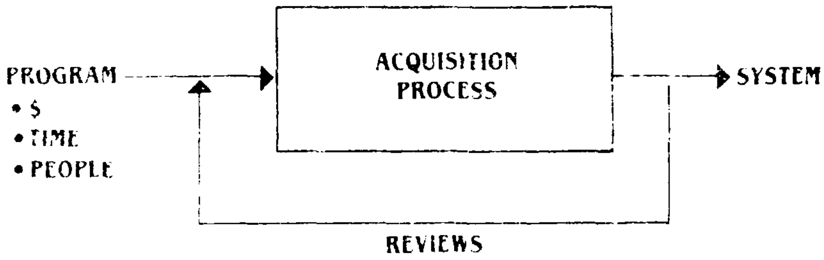
V. POLICY

It is the policy of the Department of Defense that DOD acquisition of major defense systems is carried out efficiently and effectively to achieve operational objectives of the U.S. armed forces in their support of national policies and objectives. These management principles and objectives shall also be applied to the acquisition of defense systems not designated as major. DODD 5000.1

VI. BACKGROUND AND PERSPECTIVE

"Weapon system design, test and production constitute the world's most complicated technical process (in all of recorded history)," Defense Science Board Task Force on Transition from Development to Production.

Figure 1. CONCEPTUAL MODELS



The industrial revolution saw scientific discovery and engineering application expanded at an incredible rate. As late as the early 1900s, one individual could have the breadth of knowledge, understanding, and skills to identify a need or opportunity, create a design, develop and implement, make it work and then, manufacture and sell the product. However, by the mid-1940s scientists and engineers in many disciplines found that traditional analytic approaches were inadequate. It became evident that scientific specialization was leading to difficulty of communications among desciplines. A reorientation of perspective became necessary to cope with problems brought on by the complex social and technological structures of the modern world. Interdisciplinary approaches became imperative. A systems perspective evolved.

This perspective:
—Viewed the total entity
—Defined essential elements, relationships, and interfaces (necessary and sufficient)
—Clarified dependencies and drivers
—Asserted that parts be viewed in the context of the total system
—Determined external interfaces
—Viewed the system in the context of the entire life cycle
—Required trade-offs based on cost benefit sensitivity risk analysis
—Provided a tool for communication and understanding

In the 1950s, the framework for system program management, as we know it today, was established by the Air Force Systems Command in a series of regulations. These regulations and the accompanying manuals originated in missile/space programs where failure could not be tolerated, and described how systems acquisition should be managed from formulation of a system concept until "phase-out."

In the early 1960s the systems approach was generally accepted and a joint-service school was established to teach the technique, Defense Weapons System Management Center, Wright-Patterson AFB, Ohio, forerunner of Defense Systems Management College.

The planning programming and budgeting system (a method) was established to develop mission-oriented, time-phased budgets tied to long-range planning. Traditionally, budgets had been presented to the Congress along functional lines (e.g., personnel, hardware, operations and maintenance) without regard to the interrelationships of the functions. Although the Congress still looks at the budget in functional terms (e.g., appropriations), it is justified in terms of the 5-year force structure required to perform the mission.

A conceptual model of this approach is shown in Figure 1.

In the 1970s, continued acquisition problems caused a re-emphasis of the systems approach and institutionalization of the process across the whole

federal government with OMB Circular A-109. This circular established the architecture of mission areas as a framework to prioritize programs.

To accomplish the stated DOD policy and in view of the complexity of the acquisition process, a systems approach is necessary. It implies the creation of a management technique that is able to cut across the many organizational disciplines (i.e., finance, contracting, engineering, logistics, test, production, and marketing), while effectively performing the functions of management. Detailed treatment of the systems engineering process is beyond the scope of this paper; however, references included in Paragraph II above, provide that information to the interested reader.

VII. KNOWING THE LANGUAGE

Many definitions exist for the terms commonly used when dealing with systems in DOD. The following definitions from authoritative sources are presented to enhance your understanding:

Major system means that combination of elements that will function together to produce the capabilities required to fulfill a mission need. The elements may include, for example, hardware, equipment, software, construction, or other improvements or real property. Major system acquisition programs are those programs that (1) are directed at and critical to fulfilling an agency mission, (2) entail the allocation of relatively large resources, and (3) warrant special management attention (OMB Circular A-109 April 5, 1976).

System. Any organized assembly of resources and procedures united and regulated by interaction or interdependence to accomplish a set of specific functions (Joint Chiefs of Staff (JCS) Dictionary).

System

1. Entity. An interacting set of objects forming a unified whole to realize a shared goal.

2. Method. The structure or whole formed by the essential *principles* or facts of a science or branch of knowledge or thought: an organized or *methodically arranged set of ideas*, theories, or speculations; (1) the content of laws, doctrines, ideas, or principles belonging to a philosophy, a religion, or a form of government; (2) an orderly scheme of thought or constitutions. (Webster)

System (Entity)

A composite of skilled people and equipment (hardware and software) that provide an operational capability to perform a stated mission. A complete system includes the related personnel, facilities, data, and support equipment (hardware, software and material) for its operation and support to the degree that it can be considered a self sufficient unit in its intended operational environment. The system is what is employed operationally and supported logistically. (see Figures 2 and 3). Defense Systems Management College.

Figure 2. SYSTEM MODEL (METHOD)

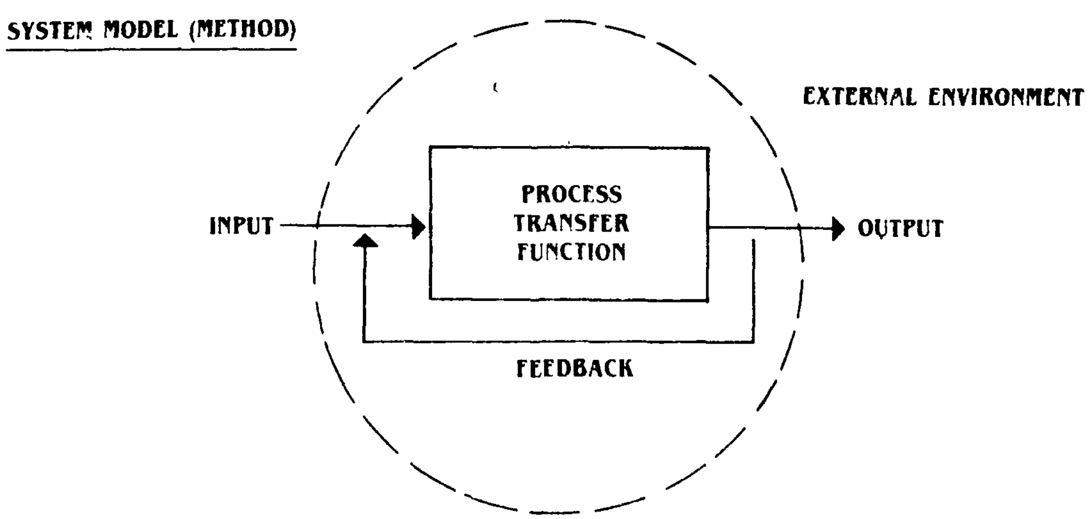
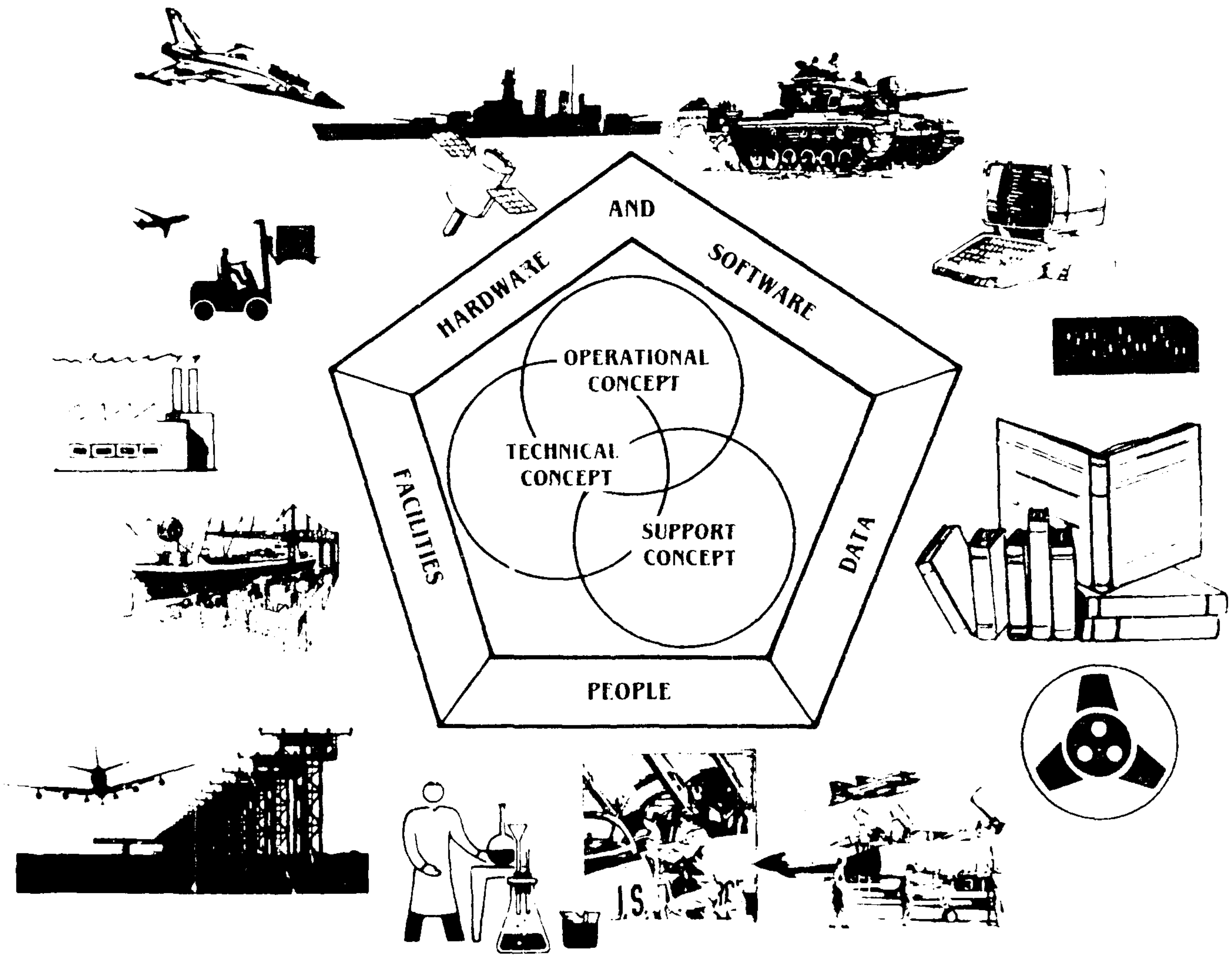


Figure 3. THE SYSTEM



Acquisition

Acquisition means the acquiring, by contract with appropriated funds, of supplies or services (including construction) by and for the use of the federal government through purchase or lease, whether the supplies or services are already in existence or must be created, developed, demonstrated, and evaluated. Acquisition begins at the point when agency needs are established and includes the description of requirements to satisfy agency need, solicitation and selection of sources, award of contracts, contract financing, contract performance, contract administration, *and* those technical and management functions directly related to the process of fulfilling agency needs by contract. (Federal Acquisition Regulation April 1, 1985).

Program. An organized set of activities directed toward a common purpose, objective, or goal undertaken or proposed by an agency in order to carry out responsibilities assigned to it. (OMB Circular A-109). (NOTE: A program can be viewed as an artificial entity; e.g., a corporation)

(Systems) Management of the acquisition of major systems includes:

—Analysis of agency missions
—Determination of mission needs
—Setting of program objectives
—Determination of system requirements
—System program planning
—Budgeting
—Funding
—Research
—Engineering
—Development
—Testing and evaluation
—Contracting
—Production
—Program and management control
—Introdution of the system into use or otherwise successful achievement of program objectives. (OMB Circular A-109).

System Acquisition Process. The sequence of acquisition activities starting from the agency's reconciliation of its mission needs, with its capabilities, priorities and resources, and extending through the introduction of a system into operational use or the otherwise successful achievement of program objectives. (OMB Circular A-109).

(System) Engineering Management. The management of the engineering and technical effort required to transform a military requirement into an operational system. It includes the system engineering required to define the system performance parameters and preferred system configuration to satisfy the requirement, the planning and control of technical program tasks, integration of the engineering specialities, and the management of a totally integrated effort of design engineering, specialty engineering, test engineering, logistics engineering, and production engineering to meet cost, technical performance and schedule objectives. (Military Standard 499A).

System Engineering Process. A logical sequence of activities and decisions transforming an operational need into a description of system performance parameters and a referred system configuration. (Military Standard 499A).

VIII. ACQUISITION MANAGEMENT PRINCIPLES AND OBJECTIVES

In addition to applying the systems approach to management, it is at times necessary in government organizations such as Congress and DOD to focus on topics of current interest. These areas of current emphasis clearly must be attended to. However, proper systems management views each topic in the context of the total system acquisition process and balances all considerations.

Every program manager should be aware of the current topics of emphasis that can be found in congressional testimony, DOD policy statements, speeches, and in the media (e.g., streamlining, warranties, spare parts overpricing).

Over time, some such topics attain permanence by being incorporated into DOD directives or instructions. Selected topics included in DODD 5000.1 are noted below; those identified in DODI 5000.2 are shown in Table 1.

Affordability. A function of cost, priority, and availability of fiscal and manpower resources, shall be considered at every milestone and during the PPBS process.

Acquisition Time. Continuing efforts to minimize the time it takes to acquire materiel and facilities to satisfy military needs.

Table 1. ACQUISITION MANAGEMENT AND SYSTEM DESIGN PRINCIPLES

The following principles shall be considered in planning major system acquisitions:

1. Mission Analysis[1]
2. Operational Requirements[1]
3. Long Range Planning and Program Stability[1]
4. Affordability[1]
5. Timeliness[1]
6. Acquisition Strategy[1]
7. Participating Activities[1]
8. Industrial Resource Analysis
9. Facility Construction (and for support of NATO missions)
10. Cost Estimated
11. Goals, Thresholds, and Threshold Ranges, as appropriate[1]
12. International Defense Cooperation
13. Economical Production Rates[1]
14. Test and Evaluation
15. Independent Cost Analysis
16. Competition[1]
17. Specification and Standards
18. Standardization and Interoperability in Engineering Design
19. Preplanned Production Improvement[1]
20. Quality
21. System Readiness, Support, and Personnel
22. Reliability and Maintainability
23. Deployment Requirements
24. System Safety
25. Physical Security
26. Nuclear and Chemical Hardness, Survivability, and Endurance
27. Producibility and Production Planning
28. Contractor's Production Capability and Contractor Productivity
29. Computer Resources
30. Data Management
31. Metric Units of Measurement
32. Electromagnetic Spectrum and Other Spectrum Allocation
33. Energy Efficiency
34. Environment Impact
35. Post Production Support
36. Administrative and Business Applications for Automated Information Systems
37. Cost Visibility and Control
38. Industrial Modernization Improvement
39. Evolutionary Development and Acquisition of Command and Control Systems.[1]

[1] For a discussion of these and other principles, see Defense Acquisition Circular (DAC)76-43. (DODI 5000.2)

Effective Design and Price Competition. Necessary for defense systems to ensure they are cost-effective and responsive to mission needs.

Improved Readiness and Sustainability. Primary objectives of the acquisition process. Resources to achieve readiness will receive the same emphasis as those required to achieve schedule or performance objectives. As a management precept, operational suitability of deployed weapon systems is an objective of equal importance with operational effectiveness.

Reasonable stability in acquisition programs. Necessary to carry out effective, efficient, and timely acquisitions. To achieve stability, DOD components shall:

(a) Conduct effective long-range planning

(b) Consider evolutionary alternatives to reduce risk; e.g., preplanned product improvements (P^3I)

(c) Estimate and budget realistically, and fund adequately, procurement (research, development, and production), logistics, and manpower for major systems

(d) Plan to achieve economical rates of production, maintain surge capacity, and conduct realistic mobilization planning

(e) Develop an acquisition strategy that sets forth the objectives, resources, management assumptions, extent of competition, proposed contract types, and program structure, and tailors the prescribed steps in the major system acquisition decision-making process to this strategy.

Tailoring and flexibility The acquisition strategy shall consider the unique circumstances of individual programs. Programs shall be executed with innovation and common sense.

Promote efficiency in the acquisition process. Authority will be delegated to the lowest levels of the component at which a comprehensive view of the program rests.

Responsibility and accountability must be clearly established. In particular, the military service program manager shall be given authority and resources commensurate with the responsibility to execute the program efficiently.

Cost-effective balance. Must be achieved among acquisition costs, ownership costs of major systems, and system effectiveness in teams of the mission to be performed.

Cooperation with U.S. allies. Will be maximized in the acquisition of defense systems to achieve the highest practicable degree of standardization and interoperability of equipment, and to avoid duplication of effort. Mobilization requirements will be a factor considered in evaluating opportunities for international cooperation.

Strong industrial base. Essential for a strong defense. To protect the public interest and foster competition, an ethical distance in business relationships between defense and industry must be maintained, without such buyer-seller relationship becoming adversarial. Technical collaboration with industry must be maintained to achieve major system acquisition objectives and meet technological challenges. The impact of DOD acquisition on the industrial base must be considered for the near term and long-range implications.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Policy and Organization Management Department
Number: 1.5
Version: Update
Date: November 1988

I. TITLE

Acquisition Strategy and Planning

II. REFERENCES

—Federal Acquisition Regulation, (FAR) Part 7

—OMB Circular A-109, "Major Systems Acquisition"

—DODD 5000.1, "Major and Non-Major Defense Acquisition Programs"

—DODI 5000.2, "Defense Acquisition Program Procedures"

—DOD FAR Supplement, Subpart 207.1

—Military Department Regulations and Documents

- —Army: AR 70-1
  AMC-TRADOC Pam 70-2
- —Air Force: AFR 57-1
  AFR 800-2
  AFSCP 800-3
- —Navy: SECNAVINST 5000.1C
  NAVMATINST 5000.29A

—*Acquisition Strategy Guide*, published by Defense Systems Management College

III. POINTS OF CONTACT

Army:
Office of the Assistant Secretary of the Army (Research, Development and Acquisition)
HQ, DA (SARD-ZR)
Washington, D.C. 20310
(202) 695-6533; AV 225-6533.

HQ, Army Materiel Command
AMCDE-A
5001 Eisenhower Avenue
Alexandria, Va. 22333
(202) 274-5100; AV 284-5100.

Navy:
Office of Naval Acquisition Support
Washington, D.C. 20364
(202) 692-3552/3.

USN, Office of Research, Development, Test and Evaluation
Staff Assistant for RDTE/Acquisition Management
Washington, D.C. 20310
(202) 695-7998; AV 225-7998.

Air Force:
HQ, USAF, Office of the Assistant Secretary of the Air Force (Acquisition)
SAF/AQXA
Washington, D.C. 20310
(202) 697-6513; AV 227-6513.

IV. PURPOSE AND SCOPE

This fact sheet is designed to:

—Discuss the concept of acquisition strategy and how it applies to the DOD acquisition process.

—Describe current DOD and service policy on acquisition strategy.

—Describe federal and DOD policy on acquisition plans, and how it relates to acquisition strategy.

V. DOD POLICY

Acquisition Strategy: DOD policy requires a comprehensive acquisition strategy covering the entire program. It is the program manager's (PM)

responsibility, by means of this acquisition strategy, to tailor the phases and milestones in DODI 5000.2 to fit the unique requirements and conditions of his program. Acquisition strategy will be summarized in each of the primary acquisition decision-making documents.

—Mission need statement (MNS) at Milestone 0 program initiation.

—System concept paper (SCP) at Milestone I.

—Decision coordinating paper (DCP) at Milestones II, III, IV and V.

Acquisition Plan: Often confused with acquisition strategy and, in fact, closely related.

—Written plan prepared in response to FAR Part 7.1 and DOD FAR Supplement Subpart 207.1

—Documents acquisition planning and summarizes various acquisition strategy elements. Describes how acquisition strategy will be implemented by contractual instruments.

—Prepared and approved through contracting channels; i.e., contracting officer prepares, head contracting activity approves or submits it up procurement chain-of-command channels.

—See Figure 1 for summary of comparison between acquisition strategy and acquisition plan.

VI. DEFINITIONS

—Acquisition Strategy: A combination of business and technical management options/approaches designed to achieve program objectives within resource constraints imposed. It is the framework for managing research, development, test, production, fielding support and other essential program activities. It is the basis for formulating functional plans; e.g., the Acquisition Plan, TEMP and ILSP.

The acquisition strategy addresses the entire life cycle; it is prepared by the components prior to initiating development and is updated as required. The acquisition strategy is summarized in the MNS and the SCP/DCP for OSD review and approval at Defense Acquisition Board (DAB) milestones.

Once approved, the acquisition strategy serves as a contract between the PM and higher management on how the program will be executed, and what resources are necessary for proper execution. It also serves as a contract among the PM and subordinate or supporting organizations on what is needed and expected from them to execute the approved program.

—Acquisition Plan: This is a formally prescribed plan (FAR and DOD FAR Supplement) that focuses on contracting activities to coordinate and integrate efforts to fulfill a service need in a timely manner and at reasonable cost.

VII. ACQUISITION STRATEGY PREPARATION AND APPROVAL

—Initially documented as brief paragraph in the MNS at program initiation. Since this often predates the assignment of a program manager and is prior to the all-important concept exploration/definition phase, this paragraph is usually a statement of general direction, and not a tailored acquisition strategy, as such.

—The critical formulation period for the acquisition strategy is the concept exploration/definition phase. The PM is normally on board and puts a personal stamp on the program by tailoring acquisition strategy to match the vision of the program with the service requirement and resource availability. A detailed acquisition strategy is summarized in the SCP and approved at the Milestone I decision review.

—The acquisition strategy is updated and refined in the subsequent acquisition life-cycle phases, and revalidated at each milestone review as a section of the DCP.

VIII. ACQUISITION PLAN PREPARATION AND APPROVAL

—Acquisition plans are required for:

—Production and service acquisitions with contractual cost estimated at $15 M total or $5 M per fiscal year.

—Development acquisitions with total contractual costs of $2 M or more.

—While the PM has overall acquisition planning responsibility, the contracting officer prepares and maintains the actual acquisition plan in accordance with the FAR and DOD FAR Supplement in response to PM direction, guided by the overall acquisition strategy and supported by the functional elements.

—The acquisition plan is reviewed and approved through the contracting/procurement chain. Approval levels are service unique.

Figure 1. COMPARISON OF ACQUISITION STRATEGY AND ACQUISITION PLAN

	PURPOSE	EMPHASIS	FORMAT	PREPARED BY	WHEN PREPARED	WHEN APPROVED	AUTHORITY/ ACCOUNTABILITY CHANNELS	POLICY/ PROCEDURES SOURCE DOCUMENTS
ACQUISITION STRATEGY	PROVIDES CONCEPTUAL BASIS OF OVERALL PLAN THAT PM FOLLOWS IN PROGRAM EXECUTION	COMPREHENSIVE OVERVIEW OF ENTIRE PROGRAM	•PRESCRIBED BY EACH SERVICE •TAILORED TO EACH PROGRAM	PM	DURING CONCEPT EXPLORATION/ DEFINITION PHASE	EARLY IN ACQUISITION PROCESS •ON OR ABOUT MS I •REVALIDATED AT EACH MILESTONE	PROGRAM EXECUTIVE OFFICER (PEO) SERVICE ACQUISITION EXECUTIVE (SAE)	A-109 DODD 5000.1 DODI 5000.2 SERVICE ACQUISITION REGULATIONS
ACQUISITION PLAN	COORDINATE AND INTEGRATE EFFORTS TO FULFILL SERVICE NEED IN A TIMELY MANNER AND AT REASONABLE COST	CONTRACTING ACTIVITIES/ ISSUES IN NEXT PHASE	•PRESCRIBED BY FAR/DFARS •STANDARD FOR ALL PROGRAMS	CONTRACTING OFFICER	PRIOR TO EACH ACQUISITION PHASE OR MAJOR CONTRACT(S)	•ON OR ABOUT EACH MS •PRIOR TO RELEASE OF RFP	HEAD OF CONTRACTING ACTIVITY (HCA) PROCUREMENT EXECUTIVE (PE)	FAR Part 7.1 DFARS Part 207.1

Figure 2. ACQUISITION STRATEGY ELEMENTS

ELEMENTS OF A-109 ACQUISITION STRATEGY	ELEMENTS OF FAR ACQUISITION PLANNING (PART 7)	*ELEMENTS OF DFARS ACQUISITION PLANNING (PART 7)	ELEMENTS OF ARMY ACQUISITION STRATEGY (AR 70-1)
—Contracting Process —Scheduling of Essential Elements —Demonstration Test and Evaluation Criteria —Content of Solicitations for Proposals —Decisions On Whom to Solicit —Methods for Obtaining and Sustaining Competitors —Guidelines for Evaluation and Acceptance or Rejection or Proposals —Goals for Design-to-Cost —Methods for Projecting Life-Cycle Costs —Use of Data Rights —Use of Warranties —Methods for Analyzing and Evaluating Contractor and Government Risks —Need for Developing Contractor Incentives —Selection of the Type of Contract Best Suited for Each Stage in the Acquisition Process —Administration of Contracts	Acquisition Background and Objectives —Statement of Need —Applicable Conditions —Requirements for compatibility with existing or future systems or programs. —Any known cost, schedule, capability, or performance constraints —Cost —Life-cycle cost —Design-to-cost —Application of should-cost —Capability or Performance —Delivery or Performance-Priced Requirements —Trade Offs —Risks Acquisition Streamlining Plan of Action —Sources —Competition —Source-Selection Procedures —Contracting Considerations Authority for Contracting By Negotiation —Budgeting and Funding Product Descriptions —Priorities, Allocations, and Allotments —Contractor Versus Government Performance —Management Information Requirements —Make or Buy —Test and Evaluation —Logistics Considerations —Assumptions determining contractor or agency support. —Reliability, maintainability, and quality assurance requirements, including any planned use of warranties. —Requirements for contractor data (including repurchase data) and data rights, their estimated cost, and the use to be made of the data. —Government-Furnished Property —Government-Furnished Information —Environmental Considerations —Security Considerations —Other Considerations —Milestones for the Acquisition Cycle —Identification of Participants in Acquisition Plan Preparation	—Applicability of a Decision Coordinating Paper, Program Memorandum, Defense System Acquisition Review Council, or Internal Service Reviews Considerations (ILSP to date) —Application of Design-to-Cost (Incl. C/SCSC) —Application of Life-Cycle Cost (Incl. C/SCSC) —Reliability and Maintainability Objective, Including Warranties —Test and Evaluation Approach —Management Information/Program Control Requirements —Approval for Operational Use —Government-Furnished Material/Facilities/Component Breakout —Application of Should-Cost —Milestone Chart Attachment Depicting the Objectives of the Acquisition —Milestones for Updating the Procurement Plan Acquisition Approach for Each Proposed Contract —Specific References to Budget Line Items and Program Elements —Market Research Efforts to Identify NDI Products	—Program Structure/Approach —Tailoring the Acquisition Process —Supportability and Transportability —Producibility and Industrial Preparedness —Test and Evaluation —Computer Resources —Manprint —Electric Power and Environmental Impacts —Cost Drivers and Discipline —Quality and Risk Management —Standardization/Interoperability/Cooperative Opportunities —Vulnerability, Survivability and Endurance —Near Term Issues —Contracting Approach —Sources —Competition —Contract Types —Budgeting & Funding —Delivery on Performance Period Requirements —Priorities, Allocations & Allotments —Security Considerations —Other Considerations —Participants/Points of Contact

*DFARS Requirements Added to FAR

IX. SERVICE POLICY ON ACQUISITION STRATEGY AND ACQUISITION PLAN

The documentation and approval prior to the DAB review is unique to each component.

—The Army PM prepares the Acquisition Strategy (AS) as a stand-alone document according to a specific format. The Acquisition Strategy is approved within the Army by the milestone decision review authority (see AR 70-1). A separate Acquisition Plan (AP) is prepared to implement the approved acquisition strategy by contract action. The Acquisition Plan is approved by ASA(RDA), the Army procurement executive (see AFARS, Part 7).

ELEMENTS OF NAVY ACQUISITION STRATEGY (NAVMATINST 5000.29A)	ELEMENTS OF AIR FORCE PROGRAM MANAGEMENT PLAN (AFR 800-2, 3)	ELEMENTS OF RECENT EXAMPLE ACQUISITION PLAN
—Section I: Needs, Constraints, Thresholds, and Program Structure —Statement of need —Program constraints and/or thresholds —Resources and funding —Program structure —Section II: Risk Analysis —Section III: Strategy to Achieve Objectives and Implementation —Objectives and goals for the acquisition effort —Considerations and rationale for program schedule —Planning and control of critical program activities —Acquisition alternatives —The plan for selecting among alternatives and the timing of key selection decisions —The interdependence of the acquisition effort with other programs —Risk Management Plan —The approach for design, hardware data development, and preplanned product improvement (P^3I) —Plans for achieving reliability in design and manufacturing —Standardization considerations —Design-to-cost and affordability considerations —Integrated logistics support approach —Use of organizational assets —Mobilization capability —A financial strategy —Plans for and funding required to acquire adequate subsystems and system test hardware —The business management approach —An audit trail of key acquisition decisions	—Program Summary and Authorization —Intelligence —Program Management —System Engineering —Test and Evaluation —Communication/Electronics —Operations —Civil Engineering —Manpower and Organization —Manpower and Organization —Personnel Training —Security —Directives Application	—Program Description —Program Funding —Delivery Requirements —Applicability of Decision Coordinating Paper (DCP) and Defense Acquisition Board (DAB) Reviews —Background and Acquisition History —Program Risks —Integrated Logistics Support (ILS) Planning —Application of Design-to-Cost (DTC) —Application of Life-Cycle Cost (LCC) —Reliability, Maintainability, and Quality Assurance (R,McQA) Objectives —Test and Evaluation Approach —Management Information and Program Controls —Approval for Full Production (AFP) —Government-Furnished Property/Facilities/Component Breakout —Should-Cost —Industrial Preparedness Planning —Other Considerations —Acquisition Milestones —Schedule for Updating the Acquisition Plan —Acquisition Plan Participants —Contracting Approach —Long-Range Plan

—The Air Force PM prepares an acquisition strategy briefing for an Acquisition Strategy Panel. This briefing and the panel recommendations are the bgasis for formal documentation of the Acquisition Plan. The Acquisition Plan is approved by the head of contracting activity (HCA) or by ASAF(ACQ), the USAF procurement executive (see AFR 800-2).

—The Navy PMs document the acquisition strategy in an Acquisition Plan (according to FAR/DFARS/NARSUP format). Acquisition plans for procurement, or procurement and RDTE are approved by ASN (S&L), the Navy procurement executive. The RDTE only acquisition plans are approved by ASN (RE&S) (see SECNAVINST 5000.1C)

—See Figure 2 for a summary of OMB, FAR, DOD FAR Supplement, and service policy on acquisition strategy elements.

FACT SHEET PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Policy and Organization Management Department

Number: 1.5.1
Version: Update
Date: November 1988

I. TITLE

Non-Development Items (NDI)

II. REFERENCES

—United States Code, Title 10, Chapter 137, Section 2325, "Preference for Nondevelopmental Items"
—DODD 5000.1, "Major and Non-Major Defense Acquisition Programs," 1 September 1987
—AR 70-1, "Systems Acquisition Policy and Procedures
—SECNAVINST, 4210.71, "Effective Acquisition of Navy Material
—AMC/TRADOC Pamphlet 70-2, "Materiel Acquisition Handbook"

III. POINTS OF CONTACT

Headquarters, Department of the Army
SARD-ZR
Washington, D.C. 20310

Headquarters, U.S. Air Force
SAF/AQXA
Washington, D.C. 20334

Assistant Secretary of the Navy
(Shipbuilding and Logistics)
ATTN: SPECAG
Department of the Navy
Washington, D.C. 20360-5000

IV. PURPOSE AND SCOPE

This fact sheet is designed to:
—Describe DOD policy on NDI
—Define and give examples of NDI
—Describe the process for tailoring an NDI acquisition strategy
—Give advantages and challenges of an NDI acquisition strategy.

V. DOD POLICY

The DODD 5000.1, requires the use of an existing U.S. or allied military or commercial system be assessed and thoroughly reviewed as an approach to satisfying a need or requirement. The directive also states that when tailoring an acquisition strategy to meet individual circumstances, consideration sho' ' be given, whenever possible and appropriate, to maximizing use of "off-the- shelf" commercial products.

The National Defense Authorization Act of 1987 requires DOD to use NDI to fulfill needs to the greatest extent possible. It also requires that DOD state its needs in terms of functions to be performed, performance required, or essential physical characteristics.

VI. DEFINITIONS

The NDI is a broad, generic term that covers materiel available from a wide variety of sources with little or no development effort required by the government.

As described in U.S. Code, Title 10, NDI includes items:

—Available in the commercial marketplace

—Already developed and in use by other U.S. military services or government agencies or by a foreign government with which the United States has a mutual defense cooperation agreement
—Already being produced, but not yet available in the commercial marketplace.

The NDI can be an item bought from any of the

above sources and used "as is." Also, an NDI can be an item bought from the above sources and requiring minor modification prior to being operationally effective. For instance an item may need militarization or ruggedization, to include environmental or nuclear protection or adaptation to conform with military electrical power standards.

All Services have examples of successful NDI programs. The Army modified a General Motors manufactured Blazer to use as a light truck, called the commercial utility cargo vehicle (CUCV) program. The Air Force modified a McDonnell Douglas passenger/freighter aircraft for its KC-10 tanker/cargo aircraft. The Navy has adopted an Israeli developed short-range remotely piloted vehicle system.

VII. THE NDI TAILORED ACQUISITION PROCESS

One of the central concepts to remember when contemplating use of an NDI is that an NDI acquisition strategy is a "tailored" variant of the standard acquisition life cycle (outlined in DODD 5000.1) rather than a separate process. As such, an NDI acquisition process begins just like the initiation of any other acquisition program, with the user establishing a materiel requirement. An NDI may be identified as a feasible solution as the user generates requirements and informally interacts with laboratories and industry.

Formal requirements document approval provides the authority to survey the market in detail and assess NDI feasibility, not only the technology, but also considering reliability, cost-effectiveness, supportability and safety. This survey is called a market investigation and is a primary activity for the Concept Exploration/Demonstration Phase. Market investigations are led by an acquisition manager/materiel developer. They vary in detail from informal telephone inquiries to comprehensive industry-wide reviews. The results provide the justification to pursue (or not) an NDI acquisition strategy.

When a determination has been made that an NDI acquisition is an available solution, the documentation to support a milestone decision review is prepared: e.g., a Systems Concept Paper, Test and Evaluation Master Plan, a draft Integrated Logistic Support Plan and an Acquisition Plan.

If the milestone decision authority approves an NDI acquisition strategy, the program proceeds, depending on the degree of modification needed, directly to production (if no modification needed), or to a combined Concept Demonstration and Validation/Full-Scale Development Phase. In the combined phase, modifications are designed/made/integrated and tested, and documentation is prepared for the final milestone review prior to production.

VIII. THE NDI BENEFITS AND CHALLENGES

The NDI offers three major benefits:

—Quick response to operational needs; time to field is greatly reduced

—Research and development costs are reduced or eliminated

—State-of-the art technology used.

The NDI also offers certain challenges, the primary ones being:

—The user may have to accept cost and performance trade-offs to accommodate using an item already produced.

—Although NDI procurement offers the opportunity to use existing test data and reduce government test and evaluation, NDI performance must still be verified and the results documented.

—Integrated logistics support activities normally accomplished in preproduction phases may have to be accelerated for NDI acquisitions and require increased "up-front" planning and resources.

—Manpower, personnel, and training are major determinants as to whether an NDI can be fielded in a strict off-the-shelf configuration, what degree of modification is required, or whether an NDI solution is viable at all. Detailed analysis of impact on training and future personnel needs must be done.

—The Services have less control over configuration of NDI than over items developed for Service use. An NDI strategy must consider the availability of the product and its support throughout the projected life cycle. It may be necessary to consider buying "up-front" support equipment and spare parts for the entire life cycle.

An NDI may present special safety and environmental problems due to lack of compliance with military standards.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Business Management Department
Number 1.6
Version: Update
Date: January 1989

I. TITLE
Acquisition Plan

II. REFERENCES

—OMB Circular A-109, April 5, 1976

—Federal Acquisition Regulation (FAR) Parts 7 and 34

—DOD FAR Supp, Parts 207 and 234

—DSMC *Acquisition Strategy Guide*, July 1984

—DSMC PM Fact Sheet 1.5

III. POINTS OF CONTACT

Army: HQDA, DALO-CPP

Navy: OPNAV, OP-090/098

Air Force: AFSC/SDX & AFIT/LSY

IV. PURPOSE AND SCOPE

Present federal and DOD policy as well as guidance in the preparation of acquisition plans.

Guide the program manager in structuring and developing meaningful acquisition plans.

V. DOD POLICY

Acquisition plans shall be prepared for:

1. Development acquisitions whose total contractual cost is estimated at $2 million or more.
2. Production and service acquisitions whose contractual cost is estimated at $5 million for any fiscal year or $15 million total.

The criteria and thresholds above do not preclude the preparation of acquisition plans for any acquisition when deemed necessary by the departments.

Acquisitions that represent a final buyout, a one-time buy, or small, repetitive buys are exempt from the requirement to prepare acquisition plans.

Acquisition plans may be written on either a system or individual contract basis except that those acquisitions whose cost exceed the criteria and thresholds above shall be prepared on a system basis to include government furnished equipment (GFE) and system support.

VI. FEDERAL POLICY (FAR)

Acquisition planning shall begin as soon as the agency need is identified, preferably well in advance of the fiscal year in which contract award is necessary.

At key dates specified in the plan, whenever significant changes occur, or at least annually, the planner shall review the plan and, if appropriate, revise it.

Agencies that have a detailed acquisition planning system in place that generally meets the FAR and DOD supplement need not revise their system to specifically meet such requirements.

The federal and DOD principles related to acquisition planning shall be applied to those acquisitions that do not require a written plan as well as those that do.

Agencies shall perform acquisition planning and conduct market surveys to promote and provide full and open competition, or, when full and open competition is not required, to obtain open competition to the maximum extent possible.

VII. FEDERAL POLICY (OMB CIRCULAR NO. A-109)

Acquisition strategy shall be developed and tailored as soon as the agency decides to solicit alternative system design concepts that could lead to the acquisition of a new system.

Steps should be taken to refine the strategy as the program proceeds through the acquisition process.

VIII. DEFINITIONS

—**Acquisition Strategy:** A combination of business and technical management options/approaches designed to achieve program objectives within resource constraints imposed. It is the framework for managing research, development, test, production, fielding support and other essential program activities. It is the basis for formulating functional plans; e.g., the Acquisition Plan, TEMP and ILSP.

The acquisition strategy addresses the entire life cycle; it is prepared by the components prior to initiating development and is updated as required. The acquisition strategy is summarized in the MNS and the SCP/DCP for OSD review and approval at Defense Acquisition Board (DAB) milestones.

Once approved, the acquisition strategy serves as a contract between the PM and higher management on how the program will be executed, and what resources are necessary for proper execution. It also serves as a contract among the PM and subordinate or supporting organizations on what is needed and expected from them to execute the approved program.

—**Acquisition Planning.** The process by which the efforts of all personnel responsible for an acquisition are coordinated and integrated through a comprehensive plan for fulfilling the agency need in a timely manner and at a reasonable cost. It includes developing the overall strategy for managing the acquisition.

—**Acquisition Plan:** This is a formally prescribed plan (FAR and DOD FAR Supplement) that focuses on contracting activities to coordinate and integrate efforts to fulfill a service need in a timely manner and at reasonable cost.

IX. PURPOSE OF ACQUISITION PLAN

To ensure the government meets its needs in the most effective, economical, and timely manner.

To reduce acquisition risk by causing the acquisition planner to "think through" the acquisition processes before the fact so that he/she is aware of the steps to be taken, activities to be integrated, problems to be resolved, and risks to be expected.

To execute an effective integration of the various functional plans such as the System Engineering Master Plan (SEMP), Integrated Logistic Support Plan (ILSP) and Test and Evaluation Master Plan (TEMP)

X. ROLE OF ACQUISITION PLAN

To serve as a top-level planning document to ensure the effective integration of the various acquisition events and activities, as detailed in the various functional plans. Reference Figure 1. In this regard the acquisition plan serves the same role that the ILSP serves in integrating the various ILS elements, objectives, events, activities, and constraints.

To serve as a "living document" in that it "matures" or "evolves" over time as more current information becomes available. Because of the evolutionary nature of the process, the FAR requires that the acquisition plan be reviewed and revised throughout the acquisition cycle.

XI. SERVICE IMPLEMENTATION

While all DOD components have responded in some measure to the OMB and DOD requirement for acquisition strategy development, there is substantial variation in emphasis on issues, approach to structure and content, and overall guidance. Service directives should be reviewed as needed

XII. REPRESENTATIVE ACQUISITION PLAN OUTLINE

An outline for a reprensentative acquisition plan is attached to this fact sheet as Enclosure 1. It represents a composite of all required acquisition plan elements of OMB Circular A-109, the FAR, and the DOD FAR Supplement. In addition, the plan includes acquisition plan elements from DOD service and agency regulatory documents. All elements

are structured into one possible acquisition plan format that includes 14 different sections as follows:

SECTION	TITLE
1.	Executive Overview
2.	Concept of Operation and Support
3.	System Planning Summary
4.	Support Planning Summary
5.	Management Planning
6.	Test and Evaluation Approach
7.	Manufacturing and Production Approach
8.	Transfer to Operational Use
9.	Security
10.	Acquisition Approach/Competition
11.	Acquisition Resources
12.	Budgeting and Funding
13.	Acquisition Schedule
14.	Risks and Issues Assessment

Enclosure 1. REPRESENTATIVE ACQUISITION PLAN OUTLINE

A. INTRODUCTION

This enclosure presents format and informational content for a comprehensive representative acquisition plan outline. The component elements of the plan have been selected from acquisition plan requirements of OMB Circular A-109, the Federal Acquisition Regulation (FAR), the DOD FAR Supplement, and selected elements of service and DOD agency acquisition plan requirements. Requirements specified at the federal and DOD levels are annotated in the plan as follows:

(O) OMB Circular A-109 requirement
(F) FAR requirement
(D) DOD FAR Supplement requirement

B. GENERAL

1. Format

Neither federal nor DOD regulatory documents specify a format.

2. Scope

Although the outline is comprehensive in scope to accommodate a wide range of system types, components, equipments, or acquisition services, it is open-ended so that new topics and elements can be introduced. At the same time, however, the planner should know that only a discrete subset of elements should be selected for a particular acquisition so that the outline can be tailored to the acquisition at hand.

The amount of information to be included within each section is a matter of judgment; however, as time passes more information will become available and should be incorporated into the plan. Additionally, the more data generated and the more analyses conducted at this point will result in less effort expended during system specification. Remember to express requirements in functional terms; e.g., address questions of "what" rather than questions of "how" unless a directed design or a design constraint is necessary.

The plan shall address all the technical, business, management and other significant considerations that control the acquisition. Specific content of the plan will vary depending on the nature, circumstances and stage of acquisition.

3. Levels of Detail

The representative outline is structured so that three levels of detail can be presented.

a. Executive Overview

The least level of detail, but the one that presents the key issues in the most compressed form is contained in Section 1, Executive Overview. Note that this section is called an overview rather than a summary because some new material not contained in the other 13 sections can be contained in this section; e.g., Product Description.

b. Acquisition Plan

The other 13 sections of the plan present the next greater level of detail. In most cases each section expands upon the summarized topics of the Executive Overview.

c. Annexes

Although annexes are optional, the planner can provide functional plans and other matters in greater detail than presented in the acquisition plan; e.g., the Management Plan.

4. Elements Common to Most Sections

a. References

Source documents used to support data, rationale, or approach presented in the indicated section.

b. Assumptions

A statement of a fact that can be reasonably accepted without question. Assumptions are used to establish a reader basis of reference. They should not be overstated (so problem is assumed away) nor should they be understated (fails to establish a common reader basis of reference).

c. Rationale

The logic to support data, rationale, or approach presented in the indicated section.

d. Risk

A measure of the probability and consequences of not achieving a defined program goal or objective. Risk involves the notion of uncertainty and the consequences of damage associated with

failure. In this context, risk relates to any potential adverse impact upon performance, cost, or schedule.

e. Issue

Any item of interest not defined as a risk, but which should be made known to a decision-maker; e.g., congressional interest would be an issue.

5. Mutually Exclusive Sections

To the extent possible, each section should contain information not addressed in other sections; e.g., each section is mutually exclusive of other sections with regard to repeat information. Thus, the subject of government furnished equipment (GFE) might be addressed in six different sections but from a different point of view; e.g., GFE as a system component (Section 3), GFE maintenance (Section 4), GFE management responsibility (Section 5), GFE testing (Section 6), GFE composite listings (Section 11), and GFE costs (Section 12). Cost data for all items should be reserved for Section 12, Budgeting and Funding.

C. SPECIFIC

Section 1, Executive Overview

Contains all the information (in a synoptic form) a decision-maker would need to render an acquisition decision or to pique his/her interest to pursue greater detail in other sections.

Section 2, Concept of Operations and Support

Describes the operational environment in which the system is to function. Such information would aid the developer in system design and support.

Section 3, System Planning Summary

Postulates system design concept. It is derived from the requirements document, and the Maintenance and Support Concepts. Performance and capability are discussed in functional terms. Gold-plating requirements are to be avoided yet clear audit trails from the requirements document should be clearly set.

Section 4, Support Planning Summary

A clear description of the maintenance concept establishes the basis for the support concept and all related logistic matters. Trade-offs involving system design, concept of operations, and system support as they impact life cycle support are key to determining affordability. Life-cycle cost criteria should be developed

Section 5, Management Planning

Discusses the management functions related to the acquisition with particular emphasis on organization and responsibilities as well as planning and control techniques. Performance, cost, and schedule thresholds need to be identified so that the breaching of a defined threshold would trigger a review of the program. This section might synopsize a Management Plan.

Section 6, Test and Evaluation Approach

This is essentially a summary of the test and evaluation master plan (TEMP). No test design planning *per se* is contained in this section.

Section 7, Manufacturing and Production Planning

Discusses the planning that precedes a production decision, e.g., decisions regarding Producibility Engineering and Planning (PEP), Low Rate Initial Production (LRIP), and second sourcing.

Section 8, Transfer to Operational Use

Discusses this very critical period when the developer "sells" the system to the using and providing organizations. Prior agreements regarding acceptability are essential.

Section 9, Security

Addresses all aspects of security to include contractor security requirements (personnel, procedures, facilities), penetration of data bases, transmission security, TEMPEST requirements, etc.

Section 10, Acquisition Approach

This section is key to acquisition strategy. It must be responsive to the Competition in Contracting Act (CICA) of 1984 yet be efficient in terms of resources and effective in terms of providing the user with a product or service with high utility.

Section 11, Acquisition Resources

A complete accounting of acquisition resources. The breakout can be in any logical manner but must be complete and current.

Section 12, Budgeting and Funding

The only section to address funds. The section must address all funding and related matters.

Section 13, Acquisition Schedule

The milestone chart is key to this section. Realistic and easily identifiable milestones must be chosen; e.g., "Acquisition Plan Approval" is preferable to "Acquisition Plan Completion" since the latter is too vague. The difference between optimistic and pessimistic schedules represents schedule impacts due to risk. As another perspective relative to cost overruns, the acquisition planner could translate the schedule "deltas" into cost "deltas" that represent potential additional program costs.

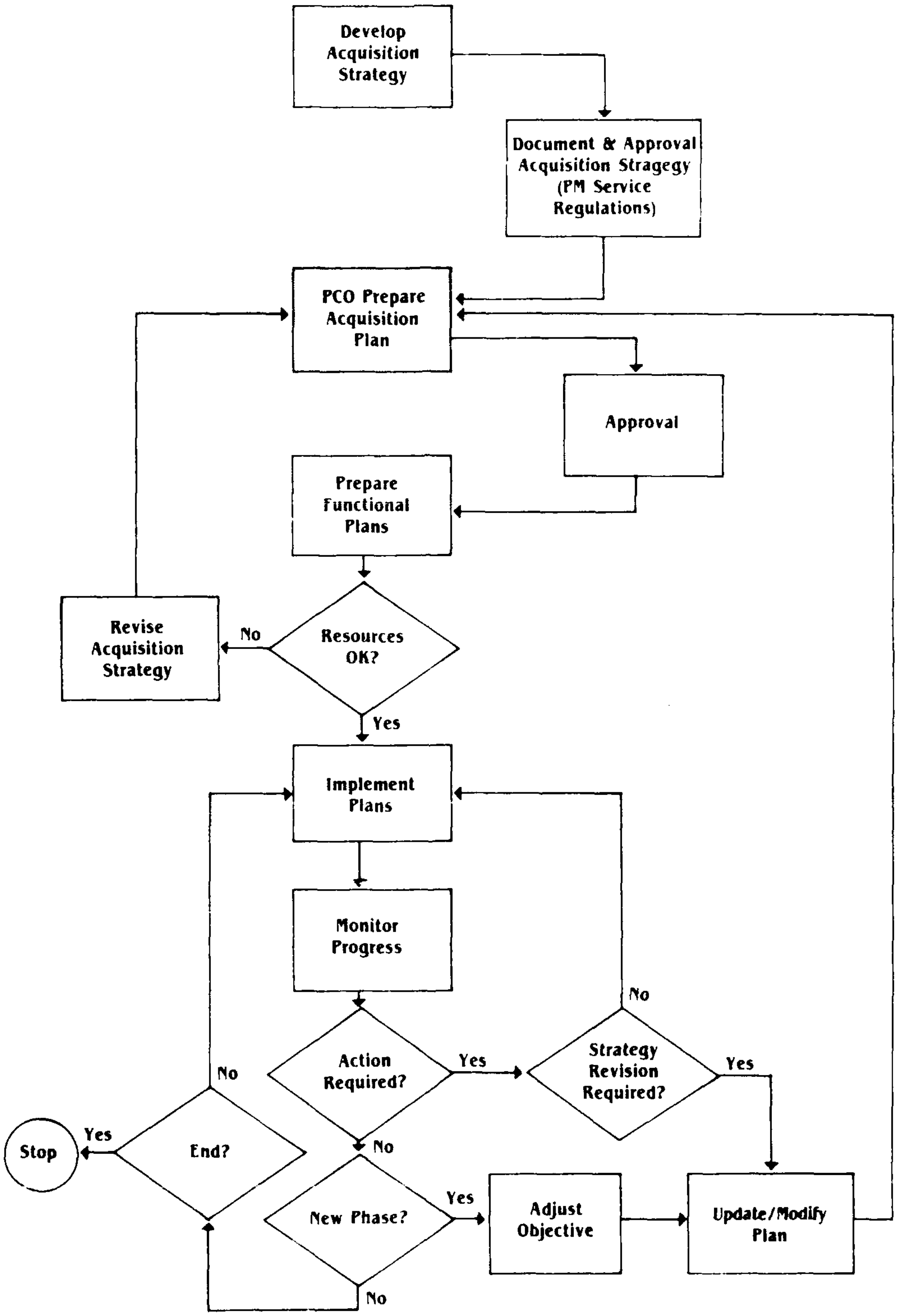
Section 14, Risks and Issues Assessment

This section synthesizes risks and issues identified in previous sections, quantifies the risk in any convenient and appropriate manner, and then provides recovery measures if such risk were to materialize. It is essential that this section be kept current since it only addresses the "known" risks. It does not address the "unknown" risks that will be manifest as the acquisition process proceeds.

5. Mutually Exclusive Sections

To the extent possible, each section should contain information not addressed in other sections; e.g., each section is mutually exclusive of other sections with regard to repeat information. Thus, the subject of government furnished equipment (GFE) might be addressed in six different sections but from a different point of view; e.g., GFE as a system component (Section 3), GFE maintenance (Section 4), GFE management responsibility (Section 5), GFE testing (Section 6), GFE composite listings (Section 11), and GFE costs (Section 12). Cost data for all items should be reserved for Section 12, Budgeting and Funding.

Figure 1. THE ACQUISITION STRATEGY DEVELOPMENT AND EXECUTION PROCESS



FACT SHEET PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department

Number: 1.7
Version: Update
Date: November 1988

I. TITLE

WORK BREAKDOWN STRUCTURE (WBS)

II. REFERENCES

—MIL-STD-881A, "Work Breakdown Structures for Defense Materiel Items"

—DODD 5010.20

—AFSCM 173-4

—AFR 800-17

III. POINTS OF CONTACT

Respective systems commands' engineering management or cost analysis offices.

IV. PURPOSE AND SCOPE

This fact sheet is designed to:

—Describe the types of WBS and their interrelationships.

—Discuss the requirements for and the utility of work breakdown structures in program planning and control.

—Discuss the preparation of a project WBS.

V. DOD POLICY

It is DOD policy that the work breakdown structure requirements established in MIL-STD-881A apply to all defense materiel items (or major modifications), which are: (a) Established as an integral program element of the 5-year defense program (FYDP); (b) where a project within an aggregated program element is estimated to exceed $10 million in RDT&E financing; (c) otherwise designated by the DOD component or under secretary for defense research and engineering; and (d) all production follow-on of the above. The MIL-STD-881A is to be used by *both* contractors and DOD components (government activities) in the development of work-breakdown structures for defense materiel items.

VI. DEFINITIONS

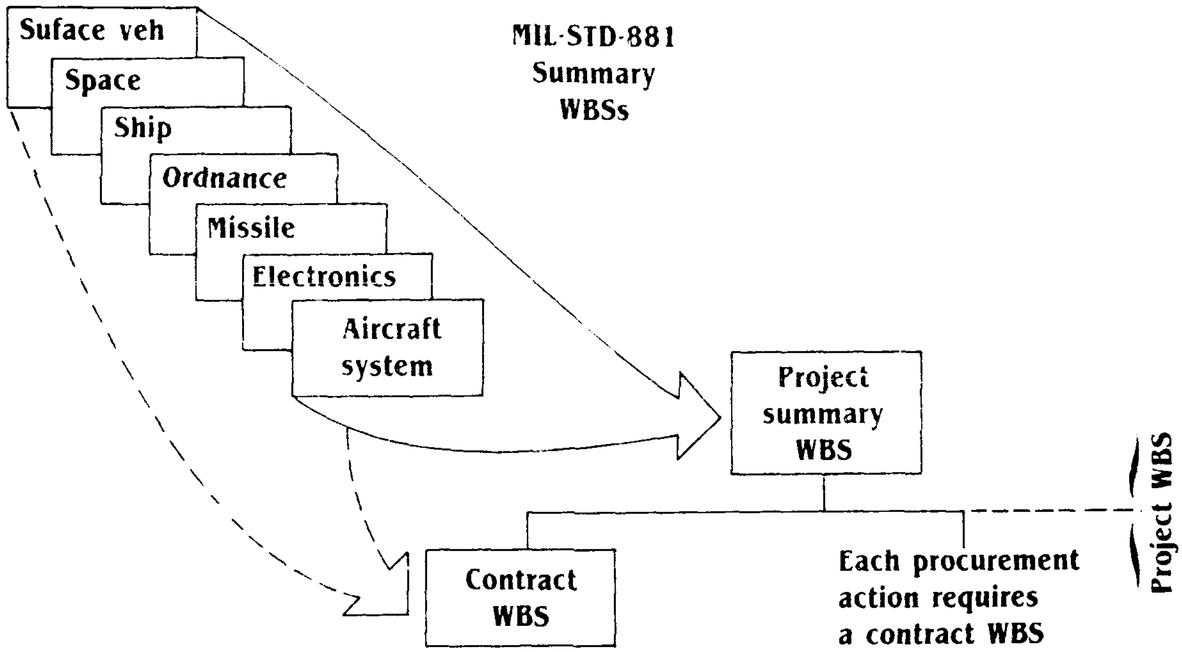
Program Element. This is the basic building block of the 5-year defense program; i.e., a description of the mission to be undertaken and a collection of the organizational entities identified to perform the mission assignment. A program element may consist of forces, manpower, materiel (both real and personal property), services, and associated costs, as applicable.

Defense Materiel Item. This is a term used within the DOD to identify a system or item that is usually established as an integral program element or is identified as a project within an aggregated program element.

Work Breakdown Structure (WBS). This is a product-oriented family tree composed of hardware, services, and data that result from project engineering efforts during the development and production of a defense materiel item, and that completely defines the project/program. A WBS displays and defines the product(s) to be developed or produced and relates the elements of work to be accomplished to each other and to the end product.

Summary Work Breakdown Structure (Summary WBS). This is a structure in which the upper three levels have been defined by MIL-STD-881A. The defense materiel items cited are aircraft systems, electronics systems, missile systems, ordnance

Figure 1. INTERRELATIONSHIP BETWEEN TYPES OF WBSs



systems, ship systems, space systems, and surface vehicle systems (see Figure 1).

Project Summary Work Breakdown Structure (Project Summary WBS). This is derived from MIL-STD-881A but tailored to the specific program or project (see Figures 1 and 2).

Contract Work Breakdown Structure (Contract WBS). The complete WBS applicable to a particular contract or other procurement action. It will generally contain the applicable portion of the project summary WBS plus any extension of levels necessary for planning and control (see Figure 1).

The contract WBS shall be constructed in a manner consistent with the levels specified in the contract, and to the extent possible, should be uniform with structures for similar defense materiel items. The contract will indicate the levels of contract WBS at which cost accumulation shall be made for reporting to the government. Traceability of cost accumulations will be required to those extended contract WBS levels that are used by the contractor for his cost control purposes (see Figure 3).

In the extended contract WBS, consideration shall be given to the specific contractual, technical, and managerial requirements of the defense materiel item. Lower levels may be configuration items, service elements, items of data or meaningful product or management oriented lower indentures of a higher-level element. The contractor has complete flexibility in extending the contract WBS to reflect how his work is to be accomplished. Particular attention shall be given to ensure the correlation of lower levels of the contract WBS to the specification tree, contract line items, configuration items of the contract, data items, and work statement tasks. The lowest level of the extended contract WBS for project planning, control, and support shall be that necessary to reach manageable units of functional tasks and shall reflect the way the work is actually being performed by the contractor or government activity.

Project Work Breakdown Structure (Project WBS). The complete WBS for a program or project, containing all elements of the Project Summary WBS and all elements of all contract WBS (see Figures 1 and 4).

Work Breakdown Structure element. This is a discrete portion of a work breakdown structure. A WBS element may be either an identifiable item of hardware, set of data, or a service. Examples of elements are aircraft system, air vehicle,

Figure 2. SAMPLE MIL STD 881A SUMMARY WORK BREAKDOWN STRUCTURE

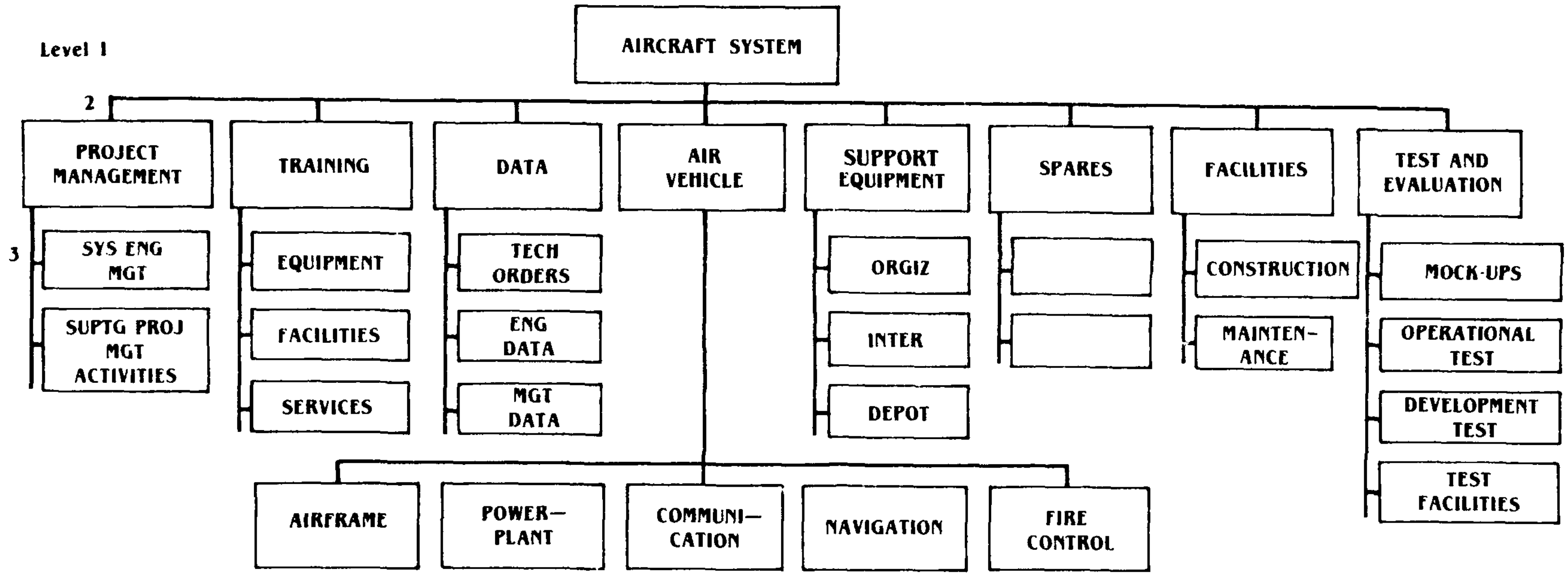


Figure 3. WBS/FUNCTIONAL INTEGRATION

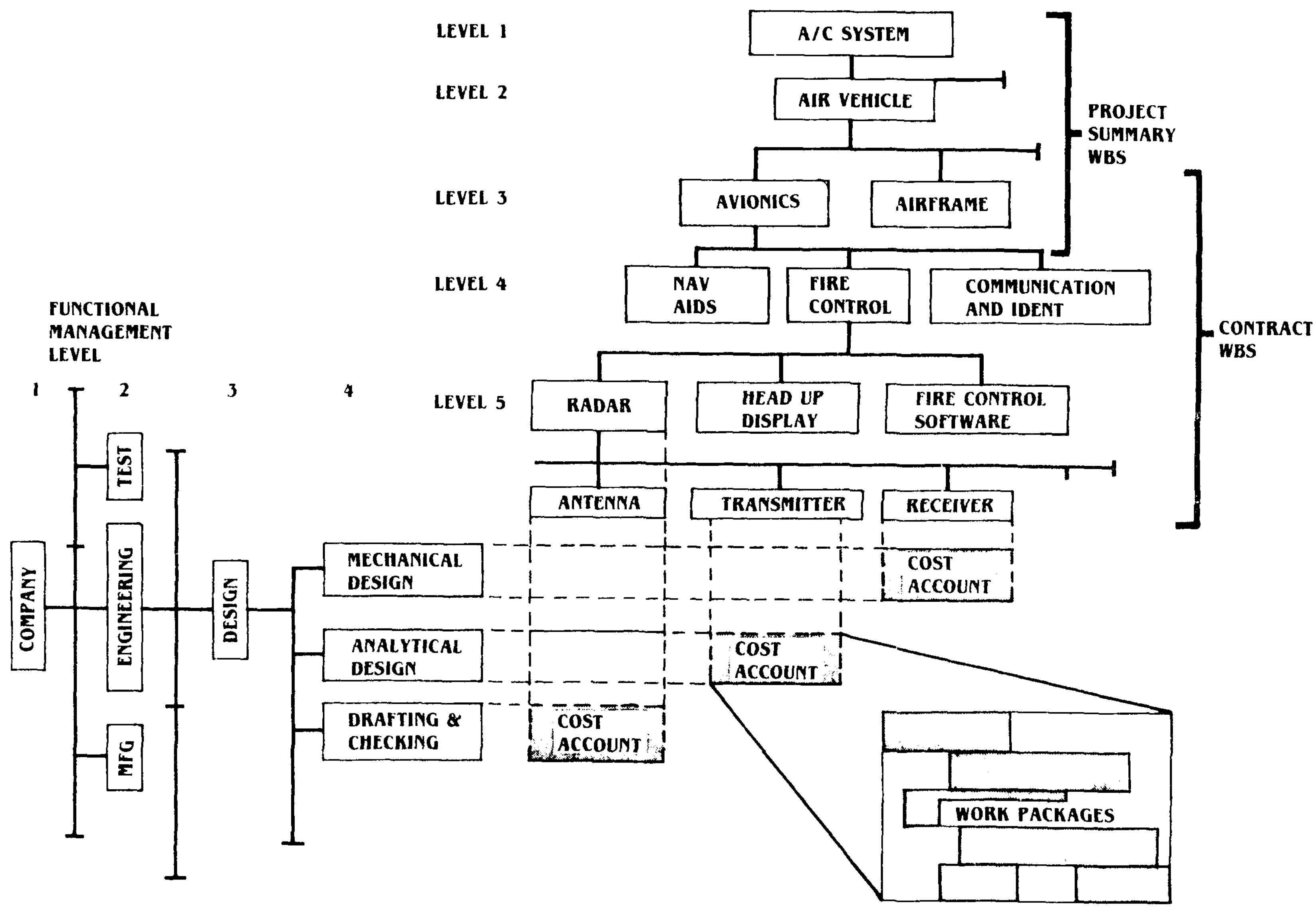
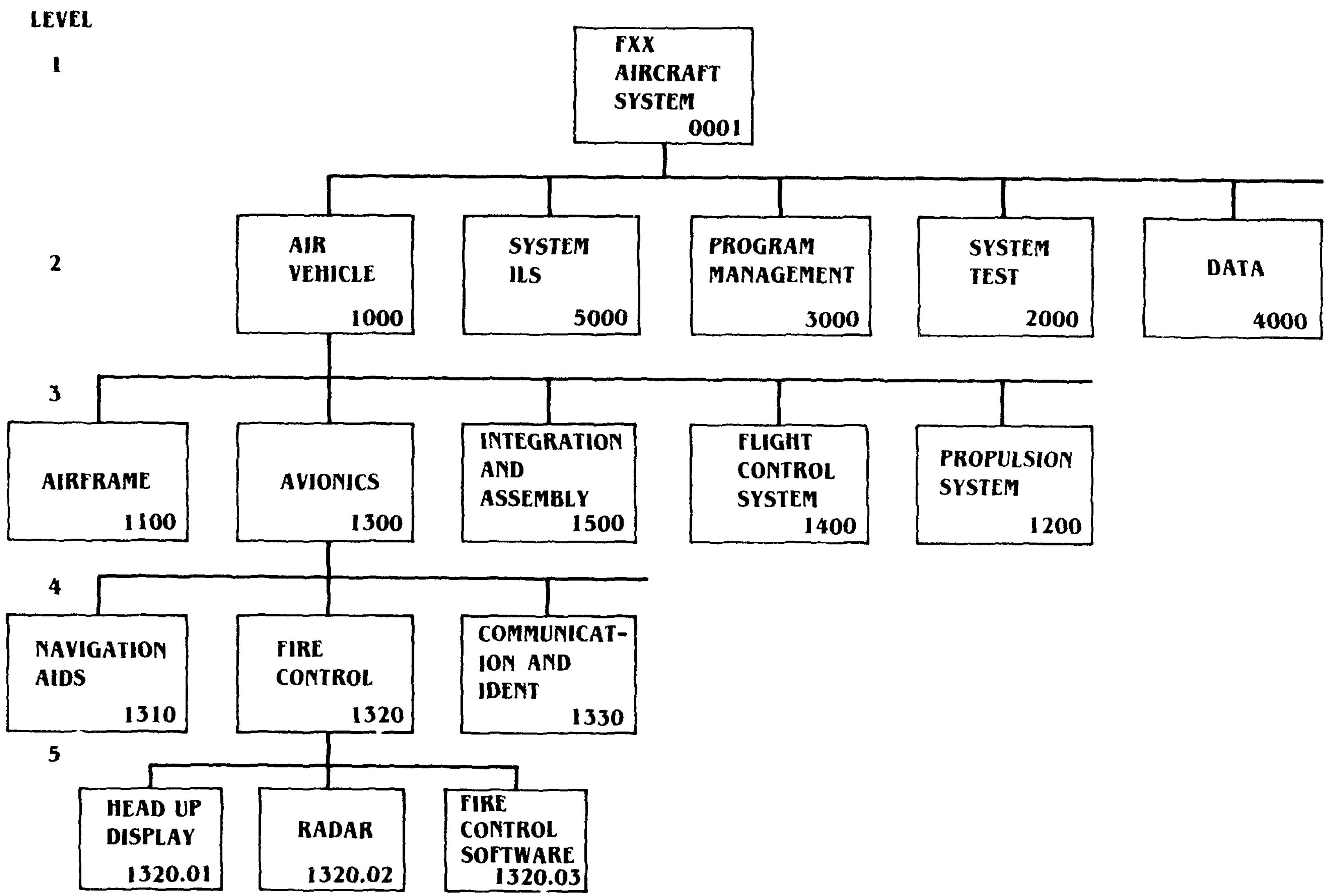


Figure 4. HYPOTHETICAL PROJECT WORK BREAKDOWN STRUCTURE (WBS)



avionics, fire control system, radar, antenna, integration and assembly, and training documentation. An element may consist of one or many work packages.

Work Breakdown Structure Work Package. A unit of work required to complete a specific job. The work must be defined, its accomplishment measureable, the effort tied to a schedule, and specific responsiblity for accomplishment made to an operating unit. The work package will represent work done at the lowest WBS level where its performance is managed. A work package is the mechanism that interrelates the "what," "who," "when," and "how much" necessary for management control of any task effort. The work package is the heart of management control and provides visibility at the level required.

Program performance is measured and controlled through reports of technical and schedule aspects of each work package, or combinations of work packages, as the need dictates. This provides the "How Goes It" for the program. This program performance measurement can be evaluated at various levels of the WBS from the program summary WBS level down to individual work packages in the contract WBS. The WBS element description becomes the "lead in" to a work package task description.

Level Identification. The three levels specified in a summary WBS and project summary WBS are:

Level 1:

The entire defense materiel item; e.g., B-1 Aircraft System, M1 Tank System, F/A-18 Aircraft System.

Level 2:

Major elements of the defense materiel itme; e.g., an air vehicle, a tracked vehicle, or aggregation of services, and activities like systems test and evaluation and data.

Level 3:

Subordinate to Level 2 major elements; e.g., an airframe, the propulsion unit, or type of service or item of data like developmental test and evaluation, or technical publications.

Work Breakdown Structure Dictionary. A set of the project WBS or contract WBS element descriptions. Generally, the elements are assigned numbers, listed sequentially in the dictionary with necessary identification, definition, objective of the element, synopsis of the effort required, and the element's relationship to other elements (see Figure 5).

VII. DISCUSSION

The WBS in its several forms is an extremely useful device as project/program managers engage in planning and controlling their projects/programs. A WBS if sufficiently written defines the program's total objectives; it relates the various work efforts (parts) to the overall product (whole). The WBS is the foundation for:

1. Program and technical planning
2. Cost estimation and budget formulation.
3. Schedule definition.
4. Statements of work and specification of contract line items.
5. Progress status reporting and problem analysis.

The project/program office builds a project summary WBS by selecting applicable elements from the summary WBS in MIL-STD-881A. From the project summary WBS, individual contract WBS can be developed. Preliminary contract WBS will be initiated by the project/program office. The contract line items, configuration items, contract work statement tasks, the contract specification, and contractor responses will be expressed in terms of the preliminary WBS. During negotiations contractors may propose changes to the preliminary contract work breakdown structure to enhance its effectiveness in satisfying the objectives of the particular acquisition. The final contract WBS will be concluded as part of the negotiation. The contractor then normally extends the levels of the contract WBS deeper in order to facilitate in-house planning and control. The contract WBS serves as the framework for the contractor's management system to provide summaries of internal data that are auditable and traceable.

The initial project summary WBS and first contract WBS will be established at the award of the first development contract. As the project develops and additional contracts are let the project WBS will extend the levels it addresses but the basic structure should remain unchanged. A single project WBS with element nomenclature and definition in *accordance with MIL-STD-881A will be maintain-*ed throughout the acquisition process to ensure traceability. It is important to emphasize several points. One, the contract WBS provides a direct

Figure 5

PROJECT/PROGRAM FXX	CONTRACT WORK BREAKDOWN STRUCTURE DICTIONARY	DATE	
CONTRACT NO.		SHEET 1	OF 1

WBS LEVEL 1	2	3	4	5	6	ELEMENT TITLE
	1000					AIR VEHICLE

ELEMENT DESCRIPTION

AIR VEHICLE

The complete flyaway FXX for delivery to the U.S. Government. The flyaway FXX constitutes the structural airframe, installed engines and subsystems, including mission peculiar equipments, as defined by the Detail Specification for Model F-XX Aircraft Weapon System including all attendant addendums and the Avionic Specification.

WBS LEVEL 1	2	3	4	5	6	ASSOCIATED LOWER LEVEL ELEMENTS TITLE
		1100				AIRFRAME
		1200				PROPULSION
		1300				AVIONICS SUBSYSTEM
		1400				FLIGHT CONTROL SYSTEM
		1500				INTEGRATION AND ASSEMBLY

structured relationship between the contracted effort and total project. Also each contract WBS must reflect interfaces necessary to other contract WBS to assure that hardware produced by different contractors or agencies will be compatible when integrated into the next higher level assembly.

The WBS elements should be selected to permit structuring budgets and identification/tracking of costs to the level required for control. This is accomplished by assigning job orders or customer orders to the cost-account level for in-house effort, and by structuring line items or work assignments on contracts in accordance with the WBS. Ordinarily a "cost account" will be established at the lowest level in the contract WBS at which costs are recorded and can be compared with budgeted costs. This cost account (WBS element) is a natural control point for cost/schedule planning and control since generally it is the responsibility of a single organizational element. Contractors maintain records to the work-package level. The government gets visibility to the cost-account level.

The WBS practices and procedures of MIL-STD-881A may be applied to system/projects other than those prescribed. A project summary WBS can be developed for any system/project regardless of size or complexity by application of the product-oriented structuring concepts.

VIII. WBS PREPARATION

1. *Summary WBS.* For the identified defense materiel items the upper three levels of a WBS are provided in MIL-STD-881A. Definitions of the elements and placement within the structure are provided. From the summary WBS a project summary WBS can be developed. The MIL STD-881A is intended to be a guide. Rigid adherence to the formats is not required.

2. *Project Summary WBS.* The project summary WBS will be prepared for a specific defense materiel item by selecting, through systems engineering and management planning processes, applicable elements from one or more of the summary WBS(s). While the categories and elements specified normally will provide the basis for constructing project summary WBS(s) deviations are permitted when they result from unique project needs determined through the systems engineering process.

The preparation of a preliminary project summary WBS will normally be accomplished as a result of systems engineering conducted during concept formulation or its equivalent. This systems-engineering effort identifies the category of defense materiel items and summary WBS elements considered to be most suitable to satisfy the operational needs. The project summary WBS will be tailored to the project objectives. Therefore in preparing a project summary WBS for any specific defense materiel item, a selection of the Level 2 and Level 3 elements from one or more of the summary WBS(s) for the appropriate category will be made. It is not necessary to include every element in the summary WBS for a specific defense materiel item's project summary WBS. Elements of the summary WBS(s) identified will use the uniform nomenclature, definition and structural placement specified for the summary WBS, unless deviation is required. The preliminary project summary WBS is not intended to be constraining. During advanced development of equivalent development efforts, changes may be proposed to this preliminary project summary WBS. Contractors may propose alternatives when warranted and exercise initiative and creativity intended to provide an improved final product.

3. *Contract WBS.* Only one preliminary contract WBS will be used in each request for a proposal and ensuing contract WBS. The project/program office will structure a preliminary contract WBS by selecting those elements of the approved project summary WBS that apply to that contract, and organizing them into a framework that supports the approved project summary WBS and the objectives of the development. Individual subsystems/hardware elements may then be extended to the next lower levels to provide management visibility and control.

Level commonality between the approved project summary WBS and the individual contract WBS need not be maintained, providing the approved project summary WBS element nomenclature and definitions are not violated. Traceable summarization of individual contract WBS(s) into the approved project summary WBS shall be maintained.

During proposal action, contractors may propose alternatives to the selected WBS elements for the proposed contract in order to enhance the effec-

tiveness of the contract WBS in satisfying the objectives of the particular project. Changes proposed by the contractor to the selected project WBS elements of the contract WBS will require approval by the DOD project manager. After necessary adjustment based on the contractor's proposals and contract negotiations, the elements selected for the contract shall become the basis for further evolutionary extension by the contractor during the contracted effort.

4. *Project WBS.* The project WBS will be constructed by the project/program office by compiling the elements of the extended contract WBS(s) with the project summary WBS. The project/program office will incorporate into the project WBS those levels of the extended contract WBS(s) that it considers necessary for project management and other related requirements. This compilation occurs as development effort identifies the successive extension of the individual contract WBS(s). The formal project WBS will be completed prior to the initiation of production.

5. *General (WBS-Related).* The definition and terminology presented in the appendices of MIL-STD-881A shall be used as the basis for structuring the specific terminology and definitions for each WBS element. The project/program office will prepare specific terminology and definitions for each preliminary contract WBS element. The contractor(s) shall prepare specific terminology and definitions for the contract extended elements of the contract WBS.

6. *Work Packages.* It is essential that work packages be established in such a manner that they provide sufficient and proper management information for project/program control. Criteria for establishing an effective work package include the following:

a. Represent specific definable unit of work
b. Define unit of work at level where work is performed
c. Relate unit of work directly to and as an extension of specific element of WBS
d. Clearly distinguished the work from that defined by other work packages
e. Assign unit of work to a specific single organizational element
f. Identify specific start to completion schedule representative of task accomplishment capability
g. Relate work package schedule directly to and as an extension of detailed program schedule
h. Identify realistic budget/resources requirements
i. Limit each unit of work to a relatively short span of time
j. Identify specific accomplishments (outputs) to result from unit of work: e.g., reports, hardware deliveries, tests.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Business Management Department
Number 1.8
Version: Update
Date: November 1988

I. TITLE

Competition for Major Systems

II. REFERENCES

—Federal Acquisition Regulation (FAR) Parts 5, 6, 7, 10, 14, 15, 27

—DOD FAR Supplement (DFARS) Parts 205, 206, 207, 210, 214, 215, 227

—Service FAR Supplements Parts 5, 6, 7, 10, 14, 15, 27

—DOD Directive 4245.9, "Competitive Acquisitions," August 1984

—DOD Directive 5000.1, "Major and Non-Major Defense Acquisition Programs," 1 September 1987

—DOD Instruction 5000.2, "Defense Acquisition Program Procedures," 1 September 1987

—DSMC Handbook, *Establishing Competitive Production Sources*, August 1984 (DTIC #ADA 146 006)

III. POINTS OF CONTACT

—Your competition advocate

—Your contracting officer

IV. PURPOSE AND SCOPE

—Describe and differentiate between design competition and production competition.

—Describe procedures for obtaining design and production competition.

—Identify significant factors that influence the production competition decision.

—Identify questions the program manager must be able to answer in developing a production competition strategy.

—Identify several alternatives to production competition.

V. DOD POLICY

The DOD policy is to award all contracts greater than $1,000 on a competitive basis. Contracts greater than $25,000 will be awarded on the basis of full and open competition. There are, of course, some exceptions to the basic policy. See FAR and DFARS Part 206 and 213.106 and FACT SHEET entitled "Competition Requirements."

The laws, from the Armed Services Procurement Act of 1947 to the Competition in Contracting Act of 1984, and the implementing regulations and directives strongly encourage "effective competition." They provide sufficient flexibility to allow the program manager, subject to the approval of seniors, to limit competition, even to the point of going sole-source, when it is deemed more effective. See FAR 6.3 and related information in the DOD and service FAR Supplements for justification and approval requirements.

While the regulations do not specifically define "effective competition," it is an important objective for the program manager to keep in mind. Effective competition, whether in the design or production phase, can be defined as competition which leads to cost-effective improvements in technical, schedule, supportability, or life-cycle cost aspects of the system, measured on a net present value basis.

VI. DESIGN COMPETITION

Establishing effective design competition is quite different, in terms of procedures, duration, and objectives, from establishing effective production competition. Design competition occurs early in the acquisition life cycle, during concept exploration/definition (CE/D), conception/demonstration/validation (CD/V), and possibly during full-scale development. The objective of design competition is to select, from competing alternative approaches, the one system or concept that will best meet the government's needs. Selection criteria may include (in order of priority) technical performance, schedule, life-cycle cost, etc. The procedures for establishing and maintaining design competition are well defined in the current instructions and directives and are the accepted way of doing business during the early phases of the acquisition life cycle. Design competition involves the solicitation of ideas from a variety of potential sources in concept exploration/definition. Several of the more promising concepts may be continued into the CD/V phase. One or more concepts may be selected for full-scale development. At some point in this process, however, a single concept is ultimately selected for production. The major question regarding design competition is not whether or not to compete, nor is it a question of how to establish design competition, but, rather, it is a question of how long to sustain some form of design competition. Is it necessary, or even desirable, to maintain competition all the way through FSD?

The answer to this question is, as always—it depends! The real, bottom-line purpose of design competition is risk reduction. Throughout the design phase, the program manager is seeking to find *the system* which he can declare, with some confidence, is producible and affordable and which represents the optimum combination of performance, schedule, supportability, and life-cycle cost.

Design competition is expensive, especially when you realize that all designs, except one, will be discontinued at some point. Each succeeding phase is more expensive than the preceding phase; therefore, the longer design competition is maintained, the more expensive it becomes. The answer to the question of how long to pursue design competition lies in the program manager's evaluation of the risk/cost equation. As soon as the PM can declare, with an acceptable degree of confidence, that he has found the *right* system, the competition should be discontinued. Preparation for production and for production competition can then begin. (Actually, planning and some preparation for production competition should have already begun.) If, for example, the CD/V phase was structured that actual prototypes of the competing systems were produced and tested, it would be possible to make the design selection before starting FSD. Only one design would proceed into FSD, saving tens or hundreds of millions of dollars over the cost of taking two or more systems into FSD. Furthermore, the time spent in FSD can be used to select and begin training the second production source. Production competition, with its cost-saving potential, could begin much sooner if design selection is not delayed until the completion of FSD.

VII. PRODUCTION COMPETITION

Production competition is different from design competition in many significant respects. Design competition is a means of finding the *right* system, with its bottom-line objective being risk reduction. Cost reduction may be a secondary objective of design competition. Production competition, on the other hand, is a means of producing similar or identical systems with its bottom-line objective being (usually) cost reduction. Risk reduction normally occurs as a by-product of production competition. Design competition competes alternative concepts, whereas production competition competes the same (or similar) concept among two or more sources. Design competition is relatively short-lived; production competition may be beneficial throughout the production phase, until a final competitive buy-out occurs. Design competition involves two or more contractors competing separate designs without sharing information; production competition frequently requires competitors to build the same system and to share data and know-how.

VIII. ESTABLISHING PRODUCTION COMPETITION

In order to establish effective production competition the program manager must be able to answer four broad questions:

—Is production competition appropriate for my program?

—Which method of technology transfer is best for my program?

—How can the chosen method be implemented successfully?

—How can the competitive environment be utilized most effectively?

The importance of understanding these questions, and tailoring answers to the unique characteristics of any given program cannot be overemphasized. The remainder of this fact sheet will elaborate further on these questions. Details of the decision process, economic analysis, and implementation strategies are beyond the scope of the fact sheet, but can be found in the DSMC Handbook, *Establishing Competitive Production Sources*, August 1984 (DTIC #ADA 146 006).

Is Production Competition Appropriate for My Program?

The answer depends on three broad factors: (1) the true objective of creating multiple sources, (2) the investment cost of creating multiple sources, and (3) a number of program-specific characteristics.

The true objective of creating multiple sources may be lower cost. It may be improvement of quality, performance, schedule, or industrial/mobilization base. If your true objective is anything other than reduced cost, you may be willing to pay a premium price to achieve that objective.

The up-front investment cost of establishing multiple sources, including data package costs, facilities costs (special tooling and test equipment) for the second source, additional qualification costs, additional government personnel and administration costs, etc., will have a direct impact on the cost-effectiveness of pursuing a competitive strategy.

There are many program-specific factors that influence not only the viability of pursuing production competition, but also have a bearing on which method of technology transfer is appropriate. Such factors include: the quantity of the system remaining to be procured, the number of years of production yet to be procured, the capacity of your current contractor, the efficiency of your current contractor, the production lead times for your system and the amount of subcontracting involved, etc.

By evaluating the three broad areas mentioned above and by performing an economic analysis of the likely investment costs, versus the projected savings, a basic decision can be made on whether or not production competition is appropriate for your system.

Which Method of Technology Transfer Is Best For My System?

Once the decision is made to establish two or more production sources, the appropriate technology transfer method must be selected. There are at least five methods, each of which has advantages and disadvantages. Each is considered appropriate under some circumstances, but none is considered appropriate under all circumstances. The five methods of technology transfer are:

Form, Fit, and Function (F^3)

The Form, Fit, and Function (F^3) technique involves solicitation of alternative products based upon performance and external interface specifications, allowing design and manufacturing flexibility. Potential second- sources are provided with functional specifications regarding overall performance, size, weight, external configuration, interface requirements, and mounting provisions. Once selected, the second supplier is given total design freedom concerning internal configuration of the equipment.

Advantages of the F^3 Technique. The primary advantage of the F^3 technique is that it does not require a detailed data package. Thus, the government need not validate and maintain a design package. Furthermore, the government need not assume responsibility or liability for technology transfer. The second-source contractor is responsible for the item design. If the end item does not meet specifications, the contractor must alter the design.

This method maximizes the potential production unit cost reduction due to competition, because each firm can design the system based upon its manufacturing process. The second-source is not constrained to manufacture to the developer's internal design.

Disadvantages of the F^3 Technique. The F^3 technique presents disadvantages. The second source

must undertake a system development program. For more complex items, this may require considerable effort in time and money, thus delaying initiation of competitive awards.

In addition, since the design of the second-source's item is different from that of the original producer, the second-source's end items must be qualified on unique test equipment. Furthermore, special tooling may be required for manufacture. Thus, the F^3 technique may involve two different sets of tooling and test equipment.

The F^3 technique leads to multiple configurations of the end items in the inventory. This may increase logistics costs by requiring two sets of test equipment and different spare parts. In addition, end-item manufacturers may be able to exercise monopoly pricing on spare parts, since they each provide unique configurations.

The F^3 technique presents the risk that, in a competitive environment, the contractor with the least appreciation for the complexity of the system may be the low bidder. Once awarded production quantities, this contractor may encounter significant problems. The program manager can minimize this problem by carefully constructing the source-selection criteria to highlight contractor awareness of critical elements, and capability to perform.

Technical Data Package

The Technical Data Package (TDP) technique of establishing a second production source involves the solicitation and selection of a second source based upon a stand alone technical data package. The TDP is procured by the government from the original developer, either by exercising a rights-to-data clause in the developer's contract or by effecting a separate procurement. Four steps are associated with technology transfer under a TDP technique:

—Preparation of the TDP by the system developer.

—Validation of the TDP by the program office (an essential step in the process).

—Acceptance and translation of the TDP by the second source.

—Second-source qualification and fabrication based on the TDP.

The key to successful technology transfer is an adequate TDP that defines the following technical aspects of the end item:

—Specific requirements of the product in terms of detailed physical and performance characteristics within the operational environment for which the product is intended.

—Quality assurance provisions, including sampling plans and acceptance criteria, acceptance inspection equipment, examinations, and tests to be conducted.

—Preservation, packaging, and packing to ensure adequate and economical preparation for delivery and protection of the product from the time of production to time of development.

—Manufacturing instructions or descriptions to ensure that contractors in the general field of capability can expeditiously initiate production of the item covered by the TDP.

Advantages of the TDP Technique. The TDP technique of establishing competitive production sources presents advantages. The program manager can use a valid TDP repeatedly to maintain competition throughout a production program. In addition, by procuring a TDP the program manager maintains the potential for future competition while committing a relatively small initial investment. This is particularly attractive because the original producer may offer lower prices as a step toward avoiding competition. Thus, the program manager may be able to realize the benefits of competition without incurring the additional tooling and qualification costs associated with competitive production. For this approach to be effective, the first producer must believe that the TDP is adequate and that potential competitors exist.

Disadvantages of the TDP Technique. The TDP technique presents disadvantages. In order to validate the TDP, the program manager must have access to a qualified engineering team. This team may be required to function through initial production to ensure resolution of data package problems.

By validating and releasing the TDP, the government assumes responsibility for its adequacy. Thus, if the TDP is insufficient to enable the second source to produce, possibly because of inadequate

drawings or differences in production processes, the government may be liable.

Given the complexity of modern weapon systems, it may be difficult to document weapon system technology strictly through drawings. Even when drawings are complete and accurate, technological differences between the two companies' manufacturing methods may preclude the second source from manufacturing strictly from the TDP. The second source may be required to undertake reverse engineering to translate the system design. This may result in later logistics complications if the two designs are significantly different.

Leader-Follower

The leader-follower technique of establishing a second production source involves direct contractor-to-contractor transfer of technical data. Subpart 17.4 of the Federal Acquisition Regulation (FAR) states that this transfer can be accomplished by awarding a prime contract to a:

—Leader company, obligating it to subcontract a designated portion of the required end items to a specified follower company and to assist it to produce the required end items.

—Leader company, for the required assistance to the follower company, and a prime contract to the follower for production of the items.

—Follower company, obligating it to subcontract with a designated leader for the requisite assistance.

The FAR considers the leader-follower concept as an extraordinary procurement technique and restricts its use to situations when the following conditions exist:

—The leader company has the necessary production know-how and is able to furnish required assistance to the follower.

—No other source of supply can meet the government's requirements without the assistance of a leader company.

—The assistance required of the leader company is limited to that which is essential to enable the follower company to produce the items.

—Its use is authorized in accordance with agency procedures.

Advantages of Leader-Follower Technique. The key advantage of the leader-follower technique is the limited government liability associated with technology transfer. Unlike the TDP technique, under the leader-follower technique the program office is not required to validate to TDP. Thus, the government need not assume responsibility for the adequacy of the data. In some cases, a complete TDP is not required.

The program office must monitor technology transfer; however, the direct contractor-to-contractor transfer facilitates the development of the second source while minimizing government involvement in technical data validation. Problems encountered in translating technical data can be solved through direct engineering exchange between the two contractors. In some cases the leader can qualify the follower for production.

Disadvantages of Leader-Follower Technique. The leader-follower technique presents disadvantages. The program manager should note that this technique is limited to programs where the original system developer can be motivated to be a leader company. Because the developer may be less than enthusiastic about assisting in the establishment of a competitor, the program manager should anticipate limited cooperation from the system developer. To enhance cooperation, innovative incentives may be required.

Another disadvantage of the leader-follower technique is that, if the follower is a subcontractor to the leader, the program office may have limited control over follower selection and technology transfer. Thus, the leader may be able to forestall competition by delaying technology transfer or selecting an incapable follower.

Licensing

The licensing technique of establishing competitive production sources normally involves inclusion of a clause in the developer's contract enabling the government to conduct a competition for a second source, select a winner, and appoint him as a licensee. The developer or licensor may be directed by the government to provide technical assistance and manufacturing data to the licensee in exchange for royalties or fees.

The program manager must recognize that, if a licensing technique is employed, the system developer retains rights to proprietary data and

maintains system responsibility. The developer grants permission to manufacture the system to the licensee through a license agreement. The agreement normally restricts use of the technology to the specific program.

Early applications of the licensing technique involve the use of a license clause in the developer's FSD contract. Recent licensing efforts, such as the cruise missile engine, have been initiated when no provision was included in the development contract. In addition, recent programs have involved developer selection of the licensee.

Advantages of Licensing Technique. The licensing technique to technology transfer presents advantages. The use of a license clause enables the program manager to maintain the potential for competition throughout the production phase of a program. The potential for competition may serve as sufficient motivation to the system developer to control costs, quality, and schedule without actually transferring technology.

In addition, the license approach enables technology transfer to be achieved with little program office involvement. Thus, the administrative burden on the program office is less than the burden associated with other techniques.

Inclusion of the license clause in the development contract establishes the potential for production competition early in the program. Detailed decisions on subcontractors and production splits can be determined as the program evolves. Thus, the program manager has ensured the potential for competition, while not committing a large amount of funds.

Disadvantages of Licensing Technique. The primary disadvantage of the licensing technique is that the system developer retains proprietary control over the design. This may complicate selection of the licensee, since the full data package cannot be released. Furthermore, the restrictions placed on the technology inhibit application of the technology to other projects. Thus, under a licensing technique, technical transfusion is slower then under other techniques where the government procures unlimited data rights.

In addition, the use of royalty fees increases the cost of the second source's end items and may preclude the second source from attaining competitive prices. The second source may be faced with an uncooperative licensor. Under a license approach, motivating the developer to assist the licensee may be difficult.

Contractor Teaming

Contractor teaming involves selecting a team of two major contractors to design, develop, and test a system through FSD. Each team member designs and fabricates subsystems and components of the system. The contractors then exchange design and manufacturing data so that both contractors are capable of producing the entire system. Following qualification, the team is split apart for competitive production.

The contractor team can be established in either of two manners. A prime contract can be awarded to one of the contractors, specifying that a subcontract be awarded to the other team member. This has the disadvantage of establishing one of the team members as a prime contractor. Another method is to allow the contractors to form a separate entity or joint venture, which has the advantage of maintaining both contractors in equally responsible roles.

Advantages of Contractor Teaming Technique. The teaming technique is attractive because of the direct contractor-to-contractor relationship. Technology transfer is achieved during the development phase when each contractor must rely on the other to supply critical subsystems and components. This reduces problems associated with proprietary data claims.

This mutual reliance provides an incentive for contractor cooperation and enhances qualification of two sources simultaneously. The simultaneous qualification of both producers establishes a competitive environment at the beginning of production. Furthermore, the direct exchange of technical data limits government involvement and liability associated with technology transfer.

In addition, the team development of the weapon system enables the program to benefit from the design talent of both contractors. This may improve the technical characteristics of the system or enhance the development of innovative designs.

Disadvantages of Contractor Teaming Technique. Associated with the apparent advantages of team-

ing are disadvantages. Until recently, contractor teaming was viewed with suspicion, due to potential antitrust problems. The program manager still must consider this potential and seek legal counsel during the initial development of a teaming approach.

In addition, contractors may view specific manufacturing processes as proprietary or trade secrets and thus not exhange all necessary manufacturing data. Once the team is split, the contractors have no motivation to continue cooperating. This potential problem can be minimized by maintaining the contractor team until both contractors demonstrate production capability.

The teaming technique is a complex undertaking, even if the contractors are dedicated to cooperation. The program manager must anticipate the involvement of two contractor management structures, provide for review of two facilities, and consider the potential geographic separation of the development effort. These factors will increase the administrative burden on the program office and complicate program management. In addition, the development effort may be more costly, due to the involvement of two contractors.

The teaming technique presents risk that, during development, the joint venture team may behave as a single entity and attempt to exercise monopoly power. The program manager must recognize that the team does represent a single developer and the benefits of competition may be limited by team actions during development.

How Can the Chosen Method Be Implemented Successfully?

Some information regarding the actual mechanics of implementing the various methods of technology transfer was included in the preceding description of the methods. Each method presents complex problems in actual implementation that are beyond the scope of this fact sheet. For more detailed guidance on the procedures, you should study carefully Chapters 9 through 13 of the DSMC handbook.

How Can Competitive Environment Be Utilized Most Effectively?

Once the competitive environment is established, new questions must be dealt with. For example, should competition be conducted on a winner-take-all-basis, or should the annual production quantities be split between the two (or more) sources? If split quantities are used, on what basis should the split be determined? What is the impact of production competition on capital investment incentive programs, such as Industrial Modernization Incentive Program (IMIP)? What about the impact of production competition on other current acquisition initiatives such as warranties, multiyear procurement, spare parts, value engineering, etc. These topics are discussed in Chapters 14 through 16 in the DSMC handbook.

IX. ALTERNATIVES TO PRIME CONTRACTOR COMPETITION

Under the best of circumstances, production competition for a major end-item is a complex undertaking. In some instances, it is better not to pursue production competition for the end-item. When production competition is not feasible, the program manager must aggressively pursue other techniques for controlling and reducing costs. Such strategies include:

—*Subcontract Competition.* This may be appropriate when a large percentage of the cost of the prime contract is passed on to subcontractors. Aggressive subcontract competition may provide substantial cost savings while avoiding up-front investment costs and additional management challenges of competition at the prime level.

—Component (or subsystem) breakout

—Multiyear procurement

—Innovative use of IMIP

—Aggressive value engineering program

—Innovative use of incentive contracts

—In-depth should cost analysis of the sole source prime

—Competition among end items

—Product improvement of an existing team

X. SUMMARY

In this fact sheet I have attempted to put the competition issue in perspective. I have discussed significant differences between design competition and production competition, and presented four questions that must be answered to develop an

effective strategy or plan for production competition, as well as alternative techniques that may be useful when production competition is inappropriate.

The bottom-line is that competition, particularly production competition, effectively executed, offers substantial benefits. It also entails significant risks. Competition planning must be an integral part of the overall acquisition strategy for the program and must be tailored to specific characteristics of the program. Finally, competition should be regarded as a means to an end—not as an end in itself.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

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I. TITLE

Independent Research and Development and Bid and Proposal Costs (IR&D, B&P)

II. REFERENCES

—FAR 31 205-18, "Independent Research and Development and Bid and Proposal Costs"

—DODI 3204.1, "Independent Research and Development"

—DODI 7700.17, "Report to the Congress on IR&D/B&P Advance Agreements Negotiated with Defense Contractors"

—AR 70-74, "Independent Research and Development"

—AFR 80-53, "Technical Evaluation of Independent Research and Development"

—NAVMATINST 3900.11c, "Industry Independent Research and Development

III. POINTS OF CONTACT

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IV. PURPOSE AND SCOPE

This fact sheet is designed to:

—Define Independent Research and Development (IR&D) and how it differs from Bid and Proposal (B&P) activities

—Identify Department of Defense (DOD) policy on IR&D

—Describe the IR&D concept and how it effects the DOD R&D process.

V. DEFINITIONS

—**Bid and Proposal (B&P) costs.** Cost incurred in preparing, submitting, and supporting bids and proposals on potential contracts. Efforts may be for either solicited or unsolicited requests for proposals on either government of non-government contracts.

—**Independent Research and Development (IR&D).** A contractor's self-directed research and development efforts. The IR&D is not sponsored or required in the performance of any contract or grant. There are four kinds of IR&Ds: Basic research, applied research, development, and systems and other concept formulation studies.

—**Basic Research.** Efforts directed toward gaining new scientific knowledge. Its primary aim is a better understanding of the subject under study, rather than a search for practical applications of existing knowledge.

—**Applied Research.** Efforts which normally occur after basic research and use its products to seek advances in the state-of-the art, and attempt to determine and exploit the potential of scientific discoveries or improvements in technology, materials, processes, methods, devices, or techniques.

—**Development,** Systematic use of scientific and technical knowledge in the design, development,

test, or evaluation of a potential new product or service for the purpose of meeting specific performance requirements or objectives.

—**Systems and Other Concept Formulation Studies.** Analyses and study efforts either related to specific IR&D efforts or directed toward identifying desirable new systems, equipment or components, or modifications and improvements to existing systems, equipment, or components.

VI. DOD POLICY

The DODI 3204.1, "Independent Research and Development," contains the DOD policy for contractor recovery of IR&D costs. The instruction specifically:

—Establishes the Technical Evaluation Group (TEG) and the Tri-Service Negotiation Group (TSNG).

—Prescribes the charter for the DOD IR&D Policy Council.

—Assigns IR&D responsibilities among DOD agencies and industry.

The TEG and TSNG serve important roles in the technical evaluation of IR&D programs. The TEG establishes criteria, methodology, and quality ratings for evaluation of contractor programs. The TEG also designates a lead military department for each contractor and provides guidance to the Tri-Service negotiator to support negotiations. The TSNG reviews the annual technical brochures and is the technical evaluator for DOD. Projects contained in contractor technical plans are kept current in a Data Bank at the Defense Technical Information Center. The Data Bank is used by all DOD components in supervising IR&D programs. The DOD may only approve a portion of a contractor's IR&D/B&P costs for inclusion in its indirect rates based upon potential military relevancy and technical quality. The evaluation process has two major objectives: (1) technical communication between government engineers/scientists and the IR&D investigators, and (2) an independent assessment of the value of the IR&D program.

The IR&D Policy Council is responsible for developing and disseminating DOD policy and guidance essential to efficient administration of IR&D and related B&P activities. The Under Secretary of Defense for Acquisition serves as the IR&D Council Chair, and the Director, Defense Advanced Research Projects Agency (DARPA), serves as the vice-Chair. Key R&D personnel from the Office of the Secretary of Defense and the Service Secretariats are council members. Advisors include representatives from NASA, OMB, and the Executive Office of the President.

The DODI 7700.17, "Report to the Congress on IR&D/B&P Advance Agreements Negotiated with Defense Contractors," prescribes an annual report to the Congress under the provisions of Section 203 of the DOD Appropriation Authorization Act of 1971 (PL 91-441). The report includes IR&D/B&P negotiations held during the previous fiscal year. Required advance agreements may be negotiated at the corporate level or with those profit centers that contract directly with the government.

VII. CONCEPT

Independent Research and Development is contractor technical effort which focuses on:

—Advancing the company technology base

—Improving current products.

—Developing new products in response to anticipated future military needs.

The IR&D is part of the cost of doing business for any technology-based company, whether or not it does any business with the Department of Defense. Almost all companies maintain active in-house R&D programs, simply to enable them to respond to changing customer needs.

The IR&D programs are the formal vehicles used to conduct such in-house efforts. Government contractors initiate and conduct IR&D programs under policies established by DOD and other government agencies. The DOD support for this industry program complements its support for each Service R&D laboratories. The primary DOD objective in supporting IR&D programs is to maintain a strong and creative industry capability which can provide new concepts and rapid response to changing military requirements.

The IR&D efforts should not be confused with B&P costs. The B&P costs are incurred by all companies to prepare their proposals. Normally, IR&D provides the basis for new proposals, thus preceding B&P efforts. Generally, IR&D is long range and broadly

scoped research, development or product improvement. It is intended to lead to new technological developments for future business. The B&P activities often channel IR&D results into particular proposals.

The IR&D and B&P costs are recovered as parts of the indirect costs allocated to all contracts, regardless of contract type. Normally, the IR&D costs are accumulated in the General and Administrative (G&A) expense category. Allocation of costs are usually on a pro-rata share allocation to all commercial, DOD, and other government contracts worked on by the contractor for the year covered by the advance agreement.

Two primary methods to determine how a company's IR&D program is considered in contractual negotiations are:

—Companies receiving more than $4.4 million from DOD in the previous fiscal year for combined IR&D and B&P costs (either as a prime contractor or subcontractor) must negotiate with the Department of Defense on advance agreement establishing its IR&D ceiling for the next fiscal year. The threshold applicable to individual corporate divisions is $550,000. Ceilings set the maximum dollar amounts of total IR&D and B&P costs that will be allowable for allocation to that part of the company's operation covered by an advance agreement. If an advance agreement is not reached, a contractor's recovery cannot exceed 75 percent of the total amount which the contractor would be entitled to receive under the contracting officer's final offer.

—For companies which are not required to have advance agreements, reimbursement is allowed up to 120 percent of average annual IR&D costs computed by using the two highest of the preceding 3 years. Although a contractor may not be required to negotiate an advance agreement, it may be done when it can be demonstrated that this formula would produce a clearly inequitable cost recovery.

VIII. CONGRESSIONAL OVERSIGHT

The difficulty in determining accurate annual expenditures in IR&D/B&P resulted in an FY 82/83 review of the program by the House Appropriations Committee (HAC) Surveys and Investigations (S&I) Staff. Hearings devoted to DOD programs produced a report which stated that IR&D programs produced much useful technology, but that limited aspects needed review and adjustment. The congressional report cited the following shortcomings:

—Total IR&D and B&P costs were not precisely known.

—The IR&D and B&P costs could be allocated by contractors against contracts which DCAA is not allowed to audit

—The IR&D and B&P charges were audited for approximately 100 large contractors but there are more than 1,300 contractors in the defense business.

—An IR&D project, which might have been part of the funded ceiling agreement, could be terminated at will by the contractor.

—All patent and data rights in an IR&D project were retained by the contractor regardless of the amount that the contractor may be reimbursed for an IR&D project through the General and Administrative allocation pool.

—Since information to the IR&D Data Bank was voluntary, there might be a number of duplicate or substantially similar projects.

Findings by the HAC staffers resulted in a requirement to maintain formal accountability for IR&D/B&P costs beginning in FY 84. The HAC directed that all IR&D and B&P costs be budgeted within the RDT&E accounts. This process is used to identify the potential annual program and not specify a budget appropriation since these projects are not funded directly by DOD; rather, funds are allocated as allowable contractor G&A expenses for DOD contracts. This change provides some management influence over the program and addresses some of the issues cited in the HAC (S&L) Report.

IX. SUMMARY

Good management of the IR&D program is essential to future technology improvements and for a sound defense program. Management of these scarce resources demands the same degree of attention as the management of major contracts.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

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I. TITLE

Motivating the Contractor

II. REFERENCES

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IV. PURPOSE AND SCOPE

This fact sheet is designed to:
—Discuss the status of government policy concerning contractor motivation
—Define contractor motivation factors
—Describe government program manager (GPM) motivation actions that promote contractor success.

V. DOD POLICY

The DOD policy covering contractor motivation at the GPM level is non-specific, located in several references, and somewhat lacking in scope, definition and cohesiveness. The OMB Circular A-76 clearly states that, "Competition enhances quality, economy and productivity." The DODD 5000.1 of 1 September 1987 directs that "Provisions for obtaining competition in each phase of the acquisition process shall be described in the acquisition strategy. This includes planning for competition for ideas and technologies in the early phases, and

the use of commercial-style competition procedures that emphasize quality and established performance as well as price during the productive phase."

This directive goes on to state, "*Industrial Base Considerations and Government-Industry Relationships*. A strong U.S. industrial base is essential for a strong defense. Accordingly, the near-term and long-term implications and ramifications of proposed acquisition programs on the U.S. defense base shall be explicitly considered during the decision making process. Additionally, technical collaboration with industry must be maintained to achieve acquisition objectives and meet technological challenges. However, to protect the public interest and foster competition, an ethical distance in business relationships between defense and industry must be maintained, without such buyer-seller relationship becoming adversarial."

The DODD 5000.43 states, in part, "Encourage and motivate acquisition activities and contractors to streamline solicitations and contract requirements."

The FAR 15.9-PROFIT states, "It is in the government's interest to offer contractors opportunities for financial rewards sufficient to (1) stimulate efficient contract performance, (2) attract the best capabilities of qualified large and small business concerns to government contracts, and (3) maintain a viable industrial base."

The above subpart of the FAR along with DFAR subpart 215.9 (1988 edition) describe policies and procedures which DOD contracting officers shall use in developing a prenegation profit or fee objective on negotiated defense contracts. The statutory ceiling in 10 U.S.C. 2306(d) and 41 U.S.C. 254 (b) on profits and fees is 15 percent R&D and 10 percent production. Within that ground rule, FAR 15.9 states (relative to profits and fees) that, "...agencies shall not (1) establish administrative ceilings or (2) create administrative procedures that could be represented to contractors as de facto ceilings." Thus when it comes to the final decision of what action will produce the best results, the GPM must consider the environment and what is best for the government, then do what is most effective for the program. Contractor motives in DOD weapon system acquisition range from a desire to be "the best" to the desire for highest rate of return on investment.

VI. CONTRACTOR MOTIVATION

In weapons system acquisition, motivation is used to achieve and maintain momentum. Through motivational actions, the GPM can communicate the program risks and concerns, give direction and highlight areas of sensitivity, emphasis or potential weakness.

At the outset, the GPM needs to evaluate his personal philosophy of leadership and direction, evaluate the corporate counterpart, the contractor program manager (KPM), and the contractor's organization. There must be an evaluation of how the respective organizations can best work together, what is the most effective forum for mutual understanding, and what will ensure attention is focused on the most important items.

The GPM must recognize that corporations are entities in the legal sense only. They are not human beings and do not react as individuals would. Motivation causes a human response and must focus on the individuals within the organization.

Government managers often charge that defense contractors are not motivated to perform; yet, the same contractor may be successful in the open market. The real question is not always whether they can perform but are they motivated to perform? Are they managed like a business, efficiently controlled and, where necessary, pulled up short on non-performance? Have they been turned off--become disenchanted and detuned to the needs of the program because of the unconscious demotivations that have crept into the program office approach. When the program office is preoccupied disproportionately with price, allows inadequate lead times, demands excessive paperwork, or provides less than definitive requirements, the contractor's respect, cooperation, teamwork and motivation to perform are imperiled and the success of the program is in jeopardy. To understand this, the program office personnel must analyze the government role and the contractor role. Both parties exhibit behavior that is a function of their individual objectives, internal motivations and external environment (areas that, in many cases, neither party can control). Most often, a key factor of success is the leadership and drive, or the lack of it, that is exhibited by the GPM and staff.

On a typical contract, there are many potential explanations for difficulties in performance. One possibility which cannot be ignored is that, in spite of a contractor's insistance and the government's inability to prove otherwise, a contractor simply may not have the technical ability to produce the required material. Similarly, the contractor may not have the management ability; the contractor may not plan well enough to get subcontractors established or to get critical materials delivered. The contractor may not have the financial savvy; they must be able to pay for people and materials they will use and to do this they must be able to obtain and plan for the use of monies. Where they exist, these limitations must be addressed realistically. Effective contractor monitoring requires good judgment, honest evaluation and flexible responses. A balanced professional view of the mission, the contract and future relations is needed to encourage success.

Exploring this issue in the limited space of this fact sheet runs the risk of oversimplification and errors of omission. It is suggested that the references provided and the points of contact identified be researched by serious practitioners. For convenient coverage, the issue is explored from the standpoint of motivation categories and GPM actions that promote success.

Contractor Motivation Categories

In weapon system contracting, contractor motivational modes fall into five basic categories; survival, profit, market share, growth and reputation. These motivations are internal forces over which the GPM usually does not have positive control or influence. By properly recognizing these modes and using them to help achieve desired outcomes, the GPM can enhance the overall program.

—*Survival*. The survival mode is the minimum sustained level of business the contractor needs to maintain integrity as an operation. When bidding on a program, contractor management in the survival mode is faced with the hard fact that they must cover payrolls, material and overhead costs and convince their personnel that jobs and opportunities will exist that allow development of both their technical and managerial skills.

The basic concerns of the GPM must be the contractor's ability to perform as needed and the firm's financial solvency. A contract placed with a contractor in this mode probably can be very attractively costed and result in program success, assuming all other risks are equal. Once the decision is made, contractor and government need to move quickly and begin work. Further motivation, if needed, can be accomplished by tying future contracts to the contingent of initial success.

—*Profit*. In the profit motivational mode, the contractor must achieve a specific return that satisfies top management and the shareholders. Profit motivational mode conditions are not stable and change with objectives of the corporation. Often, they are not similar in two sequential contracts. A company may strategically accept a loss or low profit margin for the opportunity to gain a competitive advantage. Other reasons range from developmental efforts that can evolve into areas of future business, the opportunity to spread fixed costs over a wider base, to prevent a potential competitor from gaining entry to the market, or to enable the company to attract, acquire and retain competent personnel in the scarce disciplines. Contractors in this mode can be motivated by incentive or award fees, increased sales, progress payments and government funded plant modernization; e.g., the Industrial Modernization Incentives Program. These measures must be tailored through an understanding of the contractor's long-range objectives.

—*Market Share*. In the market share motivational mode, the contractor wants what he thinks is his share of the available market. The natural inclination is to be the leader, not just a member of the group. The subtle motivation is that the corporation wants the larger share because they will be called upon as the leader, the number one in experience and as the system expert by government personnel. Once number one status has been achieved, there is a strong internal drive to maintain this position and its edge in future contracting.

The leverage the GPM has in this area is cost. Pressure can be brought to bear on a contractor through competition (with leader/follower in development or component breakout for more mature systems). Care and judgment must be exercised to ensure sufficient motivation is maintained to hold the attention of the involved contractors and ensure enough remain to sustain meaningful competition.

—*Growth*. Growth is the need for the contractor to improve his posture in any of the business senses. This can be accomplished by increasing profit, by advancing his technology state-of-the-art, by becoming the industry leader or by establishing a capability in a new field.

Contractor growth occurs in two distinct ways: growth in sales of existing products and growth in sales of new products. Growth in sales of new products is based on improved technical capability which ensures the ability to accomplish greater things and attract competent personnel. This type of growth provides desired results for the government since growth-oriented contractors breaking into the market or those expanding their capability will be almost self motivating.

To motivate, the GPM can offer the possibility of growth for better performance. For example, if the contractor in competition performs well (i.e., cost per unit is lower) then he will receive an order for a larger number of units.

—*Reputation*. Generally, contractor management wants their company known as capable, reliable, cooperative and one which can be depended upon to do a good job with a quality product at an economical cost. They are also patriotic and want to be viewed as part of the "defense team." A contractor with a good reputation is usually predictable, his past action and performance speaking for his future potential. A contractor's reputation not only works to get business, it works in attracting good capable people.

Next to surviving, maintaining the corporate reputation is perhaps the strongest motivational factor working for the GPM. A contractor will usually go to great lengths to ensure an untarnished reputation. The GPM should make clear a fair approach to reporting contractor relations.

VII. GPM ACTIONS THAT PROMOTE SUCCESS

There are four areas of motivation action that enhance chances for program success: (1) motivate through the contract, (2) encourage teamwork, (3) complement the contractor's motivation program and (4) plan and control effectively.

The GPM should include these in a plan and execute a strategy which recognizes the dominant category(s) of contractor motivation which apply to a given program and business situation.

Motivate Through the Contract

Government employees generally regard a guarantee of future business as the most effective motivator—followed by program continuity, profit, fair and equitable contracts, and competition. In contrast, members of the defense industry rank the four strongest motivators as *(1) fair and equitable contracts*, (2) guarantee of future business, (3) program continuity and (4) appropriate contract type. Profit, improved cash flow and long-term funded contracts are rated next in importance.

The GPM should develop a holistic view of contract performance factors and define requirements accurately. An example of a poorly defined modification for a combat vehicle is to have a new gun that will continuously hit a target at three miles. This isn't a realistic requirement as written. Yet, many times such a condition is imposed on a contractor because after the requirement was set down it was not reviewed or "murder boarded." The requirement does not define a black and white condition well enough and the contractor could challenge from many aspects. Is the vehicle moving? At what speed? Over what kind of terrain? Does the mounted weapon have a range of three miles? What does "continuously" mean? Is there a circle of tolerance or is the requirement implying a Circle Error Probability (CEP)? How does the GPM or the test agency measure the "implied" requirement? How does the acceptance agency state the contract met this requirement? What is the gun to do? Where? For how long?

This example represents only a simple sketch of the total problem that can be encountered when an inadequately defined requirement is imposed. When the program management office (PMO) is in discussion with the contractor or is working on the test phase of the program, ambiguous requirements must be clarified. Otherwise, the contractor will either become demotivated and lose respect for the PMO or move out and solve the conditions to his liking and the GPM has lost control.

Those areas that may lend themselves to motivation include designing in quality, focusing attention on critical items of performance, highlighting the need for a short schedule and/or minimizing the potential of a cost overrun. "Contract performance" as used here is all inclusive. It deals not

only with actual product performance but with all facets of the contract.

Another key to success is the willingness to initially lay out finite plans for accomplishment and measurement. Changes to these plans must then be individually justified. Of utmost importance, *The GPM must be assured, prior to issuance of the RFP, that there is an understanding of the overall program requirements; that they are realistic, measurable, and obtainable and that any special emphasis needed can be targeted to the proper area.*

On any specific contract, motivation is enhanced through a combination of positive and negative reinforcements. In incentive contracting, the negative motivation can be in the form of a loss of basic fee for inadequate performance. This negative aspect can then be as powerful a tool as the positive motivating technique of reward.

An associate problem is thinking money incentives solve everything. The incentive package must be tailored carefully to each situation—not just *how much* but *when* can be equally important. Internal contractor management personnel incentives are based on the current year's performance, while the contract incentive may be based on actual performance that may be determined years later. Because of this time delay, some incentives could fail to achieve the intended impact. Incentives, if utilized to motivate, must be given attention in the early phases of the contract—the most crucial period.

The GPM should be aware that some contractor team members may concentrate their efforts on meeting the fee-bearing portion of the contract at the expense of other parameters. This is not a widespread tactic, but does happen since the contractor's individual management incentives are often based on yearly sales. Control/feedback on contractor progress needs to be set up to consider such a potential.

The GPM must know what the critical program parameters are, where the potential risks are and what the budget appetite of the contractor (versus the program authorization) may be. The successfully designed contract deals with these anticipated problem areas by addressing legal recourse and incentives to alert all parties to their existence and control them as effectively as possible. At the same time, the GPM and the government contracting officer must remember that good people and materials can be obtained by the contractor only at fair and competitive prices. Even the "survival" contractor must ultimately realize a return on resources that makes defense contracting competitive with alternate business opportunities. Thus, the GPM and government contracting officer in controlling the appetite of the contractor should not expect top performance if they employ a starvation technique in structuring the RFP, executing source selection or completing negotiations.

Contractor motivational factors can be applied to any function of the contract. Generally, in setting up the contract, the GPM will visualize three conditions on each critical area: MINIMUM, ACCEPTABLE, and DESIRABLE (for lack of better definition of terms). The MINIMUM is the lowest acceptable performance required to satisfy the conditions. ACCEPTABLE is that performance that can reasonably be expected to be attained and DESIRABLE may be performance at, or beyond, the state of the art or present capability, but which, with extra work, is thought to be attainable and effective. Using these definitions, the PM should elect to contract for ACCEPTABLE, motivate the DESIRABLE and utilize the MINIMUM as a negative motivator to the contractor's profitability.

Firm, fixed-price contracts are self-motivated with respect to cost since the risk is on the contractor's side (except as discussed earlier in terms of survival). Any reasonable underrun would belong to the contractor. Care should be exercised: *The GPM must be able to finitely define what is being contracted* and assure that the requirements are achievable at the agreed-upon price. Changes desired by the GPM or other government agencies could be the downfall.

A contracting officer can, on the basis of requirements analysis and supplied information, anticipate the conditions for potentially poor contract performance. Contractors who cannot perform or those it is reasonably believed will not perform can be avoided. The reasons are varied, but failure has usually resulted from one of two basic management flaws: either the contractor doesn't have the depth in management and experience, or financ

ing and funding policies cannot support the necessary activities.

On the government side, the Program Management Office (PMO) must be set up to make quick decisions about the contract. Setting the objectives of the government team and their priority is not as simple as one might think. First of all, admitting that the PMO might trade off objectives (i.e., accept anything less than the contract requirements) is a bitter pill for the government manager and may be resisted.

Second, one might ask who selects and prioritizes the government objectives? Answering this question involves defining the government buying center. Typically, this is thought of as the GPM and a staff of experts. The buying center is actually all the organizational members involved in the purchase decision. For the government, this involves the contracting officer, assistant contract specialists, supervision, negotiators, technical personnel, requirements personnel, the System Project Officer and, as the size of the contract increases, higher levels of management up to the Secretary of Defense. This buying center must decide what is to be done in the contract and the priorities involved. This can, of course, be done in a number of ways, but probably the best is to simply assemble the decision-makers (or representatives) and negotiate a consensus.

As a net result of multilayered authority, the GPM usually is not in a position to make a quick decision and take advantage of an unforeseen opportunity. The contractor, not understanding this, becomes quickly demoralized as the PMO can't seem to do anything rapidly. The GPM and PMO staff all too often become so distracted with the mechanics of starting up a program that they fail to think critically and reason their way to a sound conclusion. What seems to happen is that "the" answer becomes more important than defining what really needs to be *accomplished, looking at* all potential alternatives and maintaining the flexibility to base decisions on current conditions. There must be a continual analysis throughout the program to be sure that the requirements are real, that the task or effort identified is possible and that any alternative ways to accomplish the task that are as efficient and cost effective have been evaluated adequately.

Finally, many PMOs start to work too late on quality, maintainability and reliability fundamentals. The key to success is the willingness to invest a large share of resources in early planning, laying out finite objectives for measurement and basing program progress on events rather than schedule oriented milestones. Both parties involved want a good product, at cost and on schedule. Working together with a firm understanding of each other's *perspectives will help avoid adversarial relation*ships and go a long way toward establishment of a win-win situation.

Encourage Teamwork

Review of past programs shows that the main ingredients of success are a close-knit team of government and contractor personnel who share a common understanding. In particular, the contractor must have a complete picture receiving all information necessary for intelligent analysis, evaluation, rationalization and trade off. Together, the GPM and contractor management must decide how they handle the science or technology that needs to be developed, assign and understand the parameter values and identify the method of tracking and reporting program risks and concerns. Too many PMOs start to work too late on the fundamentals, pushing for "progress" at the expense of solid groundwork, believing that complexity must accompany growth and that movement and motion are progress.

The GPM should always remain accessible and responsive, and be looked upon by contractor personnel as a willing and cooperative "team member." A positive, motivating atmosphere is more likely to be cultivated and sustained where fairness, openness and understanding of each other's situation is present.

One successful approach that brings people together is making them feel a part of all that happens. Show the latest test firing film to the people who made the parts, bought the components, assembled the product or tested and accepted the final product. Another successful approach is to arrange for a visit of a recognized DOD personality. Have the personality serve as part of an awards activity.

Team building is probably the single most successful tool available to the GPM for motivating

contractor personnel and the PMO staff. The team concept is essential to making everyone associated with the program feel involved. The contractor is becoming increasingly aware of this technique and the results of a joint, concentrated effort on teamwork can go a long way in breaking down adversarial roles.

Visibility is needed on the contractor floor as well as in the executive offices. Most contractor executive officers welcome a visit by the members of the government management staff. Care should be taken, however, to make this visit with the respective contractor counterpart in attendance whether a courtesy visit or a problem discussion session.

The GPM should motivate by showing job interest at all contractor work activities. Personal interactions are important and can be accomplished simply while walking through the various areas. When walking through the plant wearing the service uniform is effective—the uniform reinforces the government interest in what each worker is doing. This is not just limited to the GPM. The PMO staff can make themselves and the uniform visible, promote teamwork and lend their support also. The GPM and PMO can use personal interactions to instill even greater commitment by giving each of the contractor personnel some personal time. The first is that the workers see government interest in the product and efforts of the people. This subtly improves morale. The second is that the GPM has the opportunity to ask how things are going. The answers from this source are of the highest reliability.

The GPM needs to know the responsibilities and authorities of the KPM. What are KPM limitations; how is status determined; what progress has been made? Use of existing contractor-generated reporting data will put GPM and KPM on a common language basis. A non-cost-additive reporting system should be used.

What the GPM and KPM do, how they treat each other and how they work with one another reflects directly upon their respective organizations. Government and contractor operate in the public eye and have responsibilities to the public trust since taxpayer dollars are financing the effort. Everything must be done ethically and be worthy of scrutiny. The GPM must be aware continually of changes in corporate goals, philosophy, or organizational realignments which could impact the program. Some areas that should be monitored continually are:

—Military/commercial business mix
—Types of contracts desired or accepted
—Importance placed on profit
—Willingness to invest or take risks
— Labor pool environments
—Subcontractor disciplines.

Complement the Contractor's Motivation Program

The *DOD Incentive Guide* states, "The incentive should communicate the Program's objectives to the contractor and motivate the contractor's management to convey the governments objectives within the contractor's organization." The GPM should focus on identifying the techniques by which contractor top management internally influence the performance of their managers and workers. The GPM should then attempt to have the program complement these corporate desires and, in so doing, will be in an appreciably stronger position.

The GPM should look for a contractor structure that would provide:

—A purpose or charter that is not vague (exists and is clear)
—An organizational structure that could respond to flexible, fluid requirements
—Clean, clear lines of authority and responsibility
—People orientation
—Response to internal initiative.

The GPM should observe the organization carefully to determine not only the formal chain of command and management style, but the informal networks of information and authority. Obtaining general business information about a specific contractor is relatively easy. Information can be obtained from organizations such as the Chamber of Commerce, other equivalent agencies or sources of business information and references.

The U.S. corporations are required, by law, to file public domain documents that contain a wealth of information on present status and future planning, main sources and nature of revenues, basic business desires, information on executives (including their compensation) and internal employee

motivational plans. Typical documents that provide an excellent base for initial contractor evaluations are: annual reports, quarterly reports, proxy statements, 10K reports, and stock prospectus. Business and news journals (e.g., *Business Week, Industry Week, Financial World, Fortune, Wall Street Journal, Management Journal*) can also be used.

Information such as contractor's methods of operation, potential constraints on future behavior, performance, or other data can be obtained by requesting it in the "Request for Proposal" or in a "Letter of Clarification." Information can also be obtained from government agencies that have had experience with the contractor.

The GPM must determine the government's role in maintaining contractor employee morale. To accomplish this, the GPM needs to turn to the internal management policies, directives and established techniques to identify what he can utilize or what documents will provide an understanding of how the company operates. This documentation should be available upon request.

The GPM should support or add to any existing contractor motivational scheme. This can be accomplished by providing certificates, memorabilia, and other recognition for outstanding program accomplishment. These are not expected to be monetary awards—most contractors already have internal schemes to recognize good work "on the spot." These program awards are something the individual can display proudly in his office or home to show that he is a successful part of a team. A further benefit is that, although the award will certainly motivate, the association and recognition will have an effect on colleagues that can't be measured.

Plan and Control Effectively

The spectrum of planning and controlling effectively includes:

—Planning for the big picture
—Maintaining cost control
—Minimizing paperwork
—Dealing with external influences.

Many sources describe the mechanics of management (i.e., planning, organizing, directive, and controlling). The following treats the subject from the standpoint of motivation.

—Plan for the Big Picture

The GPM can help himself and the contractor by influencing the program from both directions, toward the contractor and toward higher government echelon. With this understanding, a team relationship can be formed which allows the GPM to tailor specific contractual measures which complement the company objectives and to provide positive motivational influences toward successful contract performance.

The GPM must consider influence on the contractor's increase of total assets through programs such as plant modernization. Hopefully, the GPM will gain ultimate cost reductions by supporting the modernization. This, however, is a two-edged sword to the contractor. Modernization (total assets increase) without good prospects for an increased volume of sales would adversely affect the turnover/personnel ratio and the Return On Investment (ROI). For example, the GPM might imply the need for a robotic line with large production numbers and then never place orders sufficient for an economical use of this production line. Programs such as the Industrial Modernization Incentives Program (IMIP) have been designed to help the GPM gain leverage in this area and to reduce contractor risk. They must be wisely implemented to be a motivator. Some programs have suffered costly instability because of unrealistic planning leading to production gaps and waste of facilitization and tooling. The problem is compounded when the procurement of the weapon system must be stretched out because the funding set aside is no longer sufficient to purchase the planned quantities at the increased costs. The additional time and money needed to produce the desired quantity routinely frustrates the budgeting and planning process.

Another source of potential delays and additional costs is the Government Furnished Equipment (GFE). This is particularly true if the end product final assembly, system operation or acceptance depends on the GFE being at the right place at the right time to accomplish government acceptance. To prevent delay and additional costs to the prime contractor, the GFE must be available at the proper time, in the needed numbers and at the set reliability.

—Maintain Cost Control

Control of cost is the nemesis of every GPM and preoccupation with total cost must not obscure attention to each cost element. In a production pro-

gram, overhead costs can easily be as high as a third or more of the program costs. Through a paring of overhead, a significant saving might be incurred. Extravagances found here are the stuff of which headlines are made.

Because customer and supplier tend to maximize their benefit/cost ratio at the expense of the other, there may be a degree of adversarial relationship and questioning of each other's actions. However, both have a vested interest in more cooperative relationships since the successful completion of the program will benefit both parties.

Utilization of a common progress-reporting technique that the PMO and the contractor understand will ensure effective communication.

—Minimize Paperwork

Data acquisition can drive up the overall program cost. Its effectiveness in serving the program is dependent on the initial definition of requirements and the careful screening of requests. The bottom line of any program should be the reduction of data cost without compromising essential information.

Present DOD initiatives strongly encourage the review and aggressive reduction of unnecessary data and specification requirements. Policy is changing toward "justifying inclusion" rather than "ordering when in doubt." Individuals requesting data may not realize the cost or be in a position to do a cost/benefit trade off. In addition, the best data package is of no use if no government personnel have time to review it. How much data to buy is a difficult question. The obvious answer is to buy what you need, understand and will use. The PMO must determine what is required and review periodically as needs change.

—Deal With External Influences

The GPM and contracting officer should recognize that the program environment is uncontrolled in the face of at least three important external influences: interest rates, inflation, and government regulations.

Interest is not an allowable cost even if directly related to the cost of a contract. However, the GPM must be sensitive to interest rates because the contractor requires money to operate. The GPM must determine that financing is available for the effort prior to award of the contract and then continually monitor to ensure that cash flows acceptably.

Inflation can destroy many plans and has impacts that can occur anywhere and anytime. An awareness of the inflation trend is essential. The financial stability of the contractor and the subcontractors are of prime importance. Many government personnel feel they are relieved of financial responsibility when their contractor accepts a fixed-price contract. This is not true when a goal of the program is success. The program cannot be successful if the commercial teammates fail to survive.

Government regulation could have an impact on the program. Examples include environmental protection and occupational safety regulations which can drastically alter manufacturing processes and significantly increase product cost. The GPM must be aware of this issue and establish a means of early warning and problem control. The contractor is equally aware of potential impacts of this nature and can exert influence via lobbying or through congressional representatives.

Review and Summary

There are five basic categories of DOD contractor motivation: survival, profit, market share, growth and reputation. The GPM should take action to build on these motivations and develop a plan which recognizes the dominant category(s) of motivation which apply to a given program and business situation. The actions described are: (1) motivate through the contract, (2) encourage teamwork, (3) complement the contractor's internal motivation program and (4) plan and control effectively.

The focus of this management issue is the development of a deep understanding of the contractor and what is important to the business operation. Then, the GPM should complement the contractor desires and goals, where appropriate, through well-thought-out plans and actions. The effective actions include development of fair and equitable contracts, emphasis on teamwork, and resonance with contractor internal motivation programs. Planning and controlling effectively, contributes significantly to motivation, understanding the big picture, minimizing paperwork, controlling cost and dealing with external influences.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 1.11
Version: Original/Current
Date: November 1988

I. TITLE

Acquisition of Nuclear-Survivable Systems

II. REFERENCES

—DOD Instruction 4245.4, "Acquisition of Nuclear-Survivable Systems"
—DOD Directive 5000.1, "Major System Acquisitions"
—DOD Instruction 5000.2, "Major System Acquisition Procedures"
—DOD Directive 5000.3, "Test and Evaluation" U.S. Army Materiel Command Regulation 70-3, "Survivability"
—NAVMAT Instruction 3401.1, "Naval Material Command Nuclear Survivability Program"
—OPNAV Instruction 3401.3, Nuclear Survivability of Navy and Marine Corps Systems"
—Air Force Regulation 80-38, "Management of the Air Force Survivability Program"
—MIL-STD-499A (USAF), Engineering Management
—MIL-STD-490A, Specification Practices
—MIL-STD-1388-1A, Logistic Support Analysis

III. POINTS OF CONTACT

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IV. PURPOSE AND SCOPE

This fact sheet conveys the perspective of acquisition management associated with nuclear survivability and not the scientific details of nuclear weapons effects. It is specifically designed to:

—Communicate the important difference between nuclear survivability and nuclear hardening.
—Provide the DOD policy that applies to the program manager.
—Explain how nuclear hardness requirements are established.
—Describe the program manager's role to develop nuclear hardened systems and acquire their coalescent nuclear hardness maintenance support.
—Reveal areas of potential problems.

V. DEFINITIONS

—Force Survivability. "The capability of the force (combat, combat support, combat service support) to avoid or, if necessary, withstand exposures to direct/indirect energy weapons effects without significantly degrading the ability and capability to perform its designated mission effectively. Force survivability is dependent on the synergistic combination of doctrine, organization, procedures, training and equipment."

—Nuclear Survivability. "The capability of a system to survive in a nuclear environment without suffering an abortive impairment of its ability to accomplish its designated mission."

—Nuclear Vulnerability. "The characteristics of a system which cause it to suffer a definite degradation (incapability to perform the designated mission) as a result of having been subjected to a nuclear environment."

—Nuclear Hardness. "A quantitative description of the physical attributes of the system or component that will allow survivability in a given weapon nuclear environment."

VI. *NUCLEAR SURVIVABILILTY versus* NUCLEAR HARDNESS

The nuclear survivability of a system is the total synergistic combination of doctrine, organization, procedures, training, operational tactics, and (if required) nuclear hardening. Tactics such as redundancy, proliferation, maneuverablity, avoidance, and stand-off may provide adequate means of survivability and may (but not usually) negate the requirement to harden a system's design. Hardening does not have to be incorporated into a design unless it is cost effective. Nuclear hardness can be achieved in two ways. One is that most systems have some inherent nuclear hardness. The other is that the ability of a system to withstand exposure can be increased through design. Again, it may be determined that the inherent nuclear hardness may meet the survivability requirements and may preclude the need to alter the design.

The degree or level of nuclear hardness to be integrated into a system's design is formally specified as "Nuclear Hardness Criteria." These criteria are treated as design requirements that are traded-off among cost, performance, schedule, and supportability. Nuclear hardness criteria are usually

specified against each type of nuclear weapons effect such as blast, thermal, radiation, EMP, etc. Once the nuclear hardness criteria are formally established, the criteria are first documented in the Type A System Specification and are then allocated down into the Type B Developmental Specifications, which are written for each of the system's Configuration Items (CIs).

There are two key points concerning Nuclear Hardness Criteria. The first is that the criteria are treated as a performance capability just like any other performance capability such as accuracy, range, speed, etc. The other key point is that once the Nuclear Hardness Criteria have been established, then the design solutions to meet hardness performance requirements must also comply with the requirements of cost, schedule, and logistics such as reliability and maintainability (just like any other performance design solution has to be traded-off among cost, schedule, and supportability).

VII. DOD POLICY

Key excerpts from DODI 4245.4:

—"Nuclear survivability and hardness features shall be included in the design, acquisition, and operation of major and non-major systems that must perform critical missions in nuclear conflicts. This includes conventional forces, non-strategic nuclear forces, strategic nuclear forces, and supporting command, control, communications, and intelligence systems."

—"Defense Acquisition Board (DAB) process shall include a careful examination of nuclear survivability and system hardness aspects.

—"Emphasis also shall be placed on recognizing the system's contribution to the success of a much larger wartime function. '

—"Nuclear hardness levels shall be validated, when possible, through a cost-effective combination of underground nuclear testing, simulation testing, and analysis. The Director, Defense Test and Evaluation, Office of the USDR&E, shall confirm that nuclear survivability and hardness objectives are achieved during development and operational test and evaluation."

—"The acquisition phase shall include the development of a cost-effective hardness maintenance and hardness surveillance program to support the operational phase of life cycle nuclear survivability."

—"Each DOD Component shall assess nuclear survivability and shall identify key uncertainties and associated risks for systems with nuclear survivability requirements."

VIII. LIFE CYCLE OF A WEAPON SYSTEM'S NUCLEAR SURVIVABILITY PROGRAM

The key elements are portrayed through the following diagram:

NUCLEAR SURVIVABILITY REQUIREMENT IDENTIFIED
·Documented in
Mission Need Statement

(IF YES) ↓

MEANS OF SURVIVABILITY ARE DETERMINED

(IF HARDENING REQUIRED) ↓

NUCLEAR HARDENING CRITERIA ESTABLISHED THROUGH TRADE-OFFS AMONG PERFORMANCE, COST, SCHEDULE, AND SUPPORTABILITY

↓

• WEAPON SYSTEM DESIGNED TO MEET CRITERIA

↓

NUCLEAR HARDNESS ASSURANCE CONDUCTED DURING PRODUCTION

↓

NUCLEAR HARDNESS MAINTENANCE IMPLEMENTED

• Nuclear hardness criteria are formally established by the service. The program manager's responsibility with nuclear hardness begins upon receipt of the formally approved nuclear criteria.

IX. NUCLEAR HARDNESS REQUIREMENT DETERMINATION

The user identifies whether the requirement is critical for a system to operate in a nuclear conflict. If the user confirms that a system must perform critical missions in a nuclear environment, then the system must be nuclear survivable. This requirement should be reflected in the Mission Need Statement (MNS). If nuclear hardening is selected as a means to enhance the survivability of the system, then the service is responsible for formally establishing the Nuclear Hardness Criteria. Ideally, the criteria should be established before Mile-

stone 0 (documented in the MNS) but no later than Milestone I. The formally established nuclear hardness criteria then become, as was mentioned earlier, a part of the performance requirement. In addition, the significant nuclear hardness thresholds for the Milestone I Defense Acquisition Board Review should be delineated in both the System Concept Paper (SCP) and the Test & Evaluation Master Plan (TEMP).

X. NUCLEAR HARDNESS PROGRAM IMPLEMENTATION

The program manager's responsibility with nuclear hardness formally begins upon receipt of the nuclear hardness criteria. Ideally, the criteria should be available at the same time the requirements document is formally approved (Milestone 0). Once the nuclear hardness criteria is formally established, the program manager must integrate the nuclear hardness requirements into the system's design just like other performance requirements are integrated into the system's design. To integrate the criteria into the system's design, the program manager should prepare a formal nuclear hardness plan. This plan should be incorporated into Part III of the Systems Engineering Management Plan (SEMP) and in any other appropriate portion of the SEMP. To ensure that the system design meets the nuclear hardness criteria, the nuclear hardness criteria are to be incorporated into the Test & Evaluation Master Plan , into the Initial Operational Test & Evaluation (IOT&E) Plan, and into the various developmental system, subsystem, component and piece-part test plans. To ensure that the production articles meet the nuclear hardness criteria, nuclear hardness assurance procedures are to be incorporated into all the appropriate aspects of the production planning effort. This involves ensuring that only Hardness Critical Items (HCIs) where specified in the engineering drawings are used and that all Hardness Critical Processes/Procedures (HCPs) where specified in specifications and drawings are adhered. In addition, all production acceptance activities should include nuclear hardness assurance procedures. To ensure that the peculiar logistics necessary to support the nuclear hardness capability is acquired in the acquisition phase, it is prudent to develop a formal Nuclear Hardness Maintenance Plan and to incorporate it into the Integrated Logistics Support Plan (ILSP). The major functions which should be addressed in the plan are as follows:

- —Nuclear Hardened Parts Control
- —Configuration Control of the System's Integral Nuclear Hardness Design
- —Nuclear Hardness Documentation Maintenance
- *—Nuclear Hardness Maintenance
  - —Organizational Peculiar Support Requirements
  - —Intermediate Peculiar Support Requirements
  - —Depot Peculiar Support Requirements
  - —Nuclear Hardness Training for Engs, Techs and Managers
- **—Nuclear Hardness Surveillance: Depot Technician Function
- ***—Nuclear Hardness Evaluation: Engineering Function

* The activity at the organization, intermediate, and depot levels of maintenance to detect, fault isolate, and repair failures in the numerous nuclear hardness designs, which have been incorporated into a system.

** Experience reveals that the nuclear hardness in fielded systems has degraded through various means such as aging operations, maintenance, and modifications. Surveillance is the inspecting and testing of fielded systems at random to detect and isolate degradations and faults in nuclear hardness. With the proper facilities, equipment, and procedures provided, this function can be performed by technicians as opposed to engineers.

*** Data gathered from surviellance testing is evaluated to predict the health of the system's hardness force wide. The scope of the evaluation function also involves determining the impact to systems due to changes in the nuclear threat. This function is usually performed by engineers and scientists not technicians.

The program manager should realize that to implement the above is no small task. What is done most often and is the prudent course of action is that program managers have one or more nuclear

survivability experts. These experts can either reside within the program office or within a matrixed function or both.

XI. POTENTIAL PROBLEM AREAS

Delays In Implementation. Contractors tend to delay addressing nuclear survivability. The impact of the contractor delay can cause the following:

—Long lead nuclear hardened items not available for final prototypes
—Space to incorporate into the design not available
—Resources inadequate to incorporate required design changes.

The key is to provide attention early. The program manager should make her/his expectations known by enforcing milestones and by evaluating the contractor's task performance.

Why Is Simulation Coupled With Analysis Important? (Nuclear Test-Ban Treaty) Because of the Nuclear Test-Ban Treaty, the program manager cannot expose the system to the real nuclear weapons effects environment. As such, simulation and analyses are critical for accomplishing the necessary test and evaluations. No nuclear weapons effects simulator duplicates every nuclear weapons effects threat environment. Analyses are needed to fill the voids from simulation (i.e. the synergistic impacts of different environments) and to extrapolate from simulated level testing to projected threat levels. The PM needs to develop a comprehensive, yet cost-effective, nuclear hardening test and evaluation program which includes both simulation and analysis. The methodology must validate with high confidence that the developed design meets the threat.

FACT SHEET PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 1.12
Version: Original
Date: December 1988

I. TITLE

Program Baselines and Milestones

II. REFERENCES

—Office of Management and Budget (OMB) Circular A-109, "Major System Acquisitions," April 5, 1976

—DODD 5000.1, "Major and Non-Major Defense Acquisition Programs," September 1, 1987

—DODI 5000.2, "Defense Acquisition Program Procedures," September 1, 1987

—DODD 5000.45, "Baselining of Selected Major Systems," August 25, 1986

—Defense Authorization Act of 1987, Sections 904, 905 and 906

Fact Sheet 4.11, "Configuration Management"

III. POINTS OF CONTACT

—Defense Acquisition Executive (DAE), the principal acquisition advisor to the Secretary of Defense.

—Service Acquisition Executive (SAE), the senior procurement executive for each military department.

—Program Executive Officer (PEO), the official responsible for administering SAE-directed programs.

IV. PURPOSE AND SCOPE

This fact sheet provides a perspective of:

—Baselines that briefly summarize the evaluation factors critical to the success of the program.

—The five acquisition phases and their milestone review points used to enhance management effectiveness.

V. DOD POLICY

It is DOD policy to assure a timely, efficient and effective acquisition. This acquisition process is designed to achieve operational objectives to support national policies and objectives. The OMB Circular A-109 guides the process. Milestone reviews separate the five phases to enhance management effectiveness. Tailoring phases minimizes acquisition time and life-cycle costs. This streamlining is consistent with the urgency of the need, the degree of technical risk involved, and demonstrated test results. At each milestone, the Defense Acquisition Board (DAB), a senior Department of Defense (DOD) acquisition review board, assists the DAE with the program milestone review.

VI. DEFINITIONS

To have meaning, baselines must be current and reflect the latest program direction and funding requirements. Each program milestone review point addresses program baselines and documents changes.

—Baselines. A baseline serves as formal documentation of an agreement by the participants at a point in time. This baseline agreement is a standard for change measurement. The baseline historically documents the change as it creates a "new" baseline.

—Milestone. A milestone is a decision point in time. When a program completes one phase and is ready to transition to another phase, a milestone defines that point in time.

VII. BACKGROUND

Baseline management provides a monitoring framework. It documents the progressive definition of a system at milestone review points. It serves as a charter of success standards to achieve. Also, baselines are a record to evaluate program accomplishments and changes before entering the next phase of the acquisition cycle.

VIII. BASELINES

All programs that have progressed past a DAB with a discrete end product must establish a program baseline. A program baseline defines the program content. Each program is unique and the baselines are tailored for the appropriate circumstances. In general, DOD programs have program, cost, schedule and performance baselines.

Except for "Foreign Military Sales" and "Level of Effort" programs, all programs will have a baseline. The program manager has overall responsibility for completing and briefing the baselines; however, functional experts prepare the specific baseline details. Baseline completion is the responsibility of the program manager, who will rely on inputs from the program office team.

—Program. The DODD 5000.1 and DODI 5000.2 define program baselines. The DODD 5000.45 provides preparation instructions. The program baseline is a formal commitment among all program participants; e.g., DAE, SAE, PEO and the program manager. It documents the program evaluation standard. The program baselines are reported at Milestones I-IV. They briefly summarize the program's functional specifications, cost, schedule objectives, operational effectiveness and suitability requirements and factors critical to program success.

The Mission Need Statement serves as the program baseline at Milestone 0. Annex B, Program Goals and Thresholds, of the System Concept Paper in the Milestone I Acquisition Decision Memorandum is the "program baseline." The program baselines and the decision milestones are listed below:

Milestone	Program Baseline
0	Mission Need Statement
I	Program
II	Development
III	Production
IV	Operational Support
V	Production (Updated)

Unless given during the Planning Programming and Budgeting System (PPBS) process, approval of the DAE is required for baseline changes. If the provisions of the baseline are breached or are in jeopardy of being breached, a deviation report is submitted to the SAE. The DAE is notified within 45 days. Within the scope of the program baseline, the program manager is given full authority to manage the program.

—Cost. Cost baselines are important. They provide a contract between the program manager and the baseline approval authority regarding program content, schedules and cost. It reflects the program manager's estimate of the cost to accomplish the program. For cost accounting and tracking, all programs will have a cost baseline regardless of size or source of funds. Cost baselines track from the most recent funding point; e.g., President's Budget, Program Objectives Memorandum, or Budget Estimate Submission.

Funding changes caused by PPBS decisions exempt changes in the Program Baseline. These changes must be highlighted by component heads to the DAE within 45 days.

—Schedule. Schedule baselines consist of the time phasing of significant events; e.g., Gantt chart, Figure 1 "Phases in the Acquisition Cycle," etc. A baseline can exist of a single event; e.g., the next DAB, Initial Operational Capability (IOC), etc. They generally consist of the start and end dates of an activity. Those activities whose accomplishment is crucial to program success are displayed on the program "critical path."

—Technical Performance Measurement. The MIL S-499A (USAF), Engineering Management, and fact sheet "Technical Performance Measurement," Figures 4 and 5, provide graphical illustrations of Technical Performance Measurement (TPM) parameter data and its evolution. Similarly, Fact Sheet 7.3 "Industrial Modernization Incentives Program (IMIP)," Figure 1, depicts another type of baseline and TPM changes. Fact Sheet 4.11, "Configuration Management," explains the three configuration (functional, allocated and product) baselines. These may also be referred to as "Requirements Baselines."

IX. MILESTONES

Milestones are those review points in time when a DAB evaluates the program. The DAB then makes

a decision recommendation to the Secretary of Defense. The acquisition process is normally divided by milestones into five phases:

—**Milestone 0,** *Program Initiation/Mission-Need Decision.* Approval or disapproval of a mission need and decision to enter into the "Concept Exploration/Definition" phase. This milestone approves program initiation and authority to budget for a new program. Primary considerations are: mission area analysis, affordability and life-cycle costs, modifications to existing U.S. or allied systems and operational utility assessment.

—**Milestone I,** *Concept Demonstration/Validation Decision.* This review addresses the decision to proceed into the "Concept Demonstration/Validation" phase. Considerations are: program alternative trade offs; performance, cost and schedule trade offs; acquisition strategy, prototyping, affordability and life-cycle costs. Other considerations are: potential common-use solutions and cooperative development opportunities. This review establishes broad program cost, schedule, and operational effectiveness and operational suitability goals and thresholds. The principles of acquisition streamlining and design-to-cost are emphasized at this review.

—**Milestone II,** *Full-Scale Development Decision.* This review decides whether to proceed into the "Full-Scale Development (FSD)" phase. If appropriate Low-Rate Initial Production (LRIP) is approved to verify production capability. Also, LRIP can provide test resources needed to conduct interoperability, live fire, or operational testing. The Milestone II Committee review occurs before the release of the final FSD Request for Proposals. Considerations are: affordability versus military value and operational suitability/effectiveness, risks versus benefits, development transition to production, industry surge/mobilization capacity, program stability, potential common use solutions and test results. Other considerations are: personnel training and safety assessments; procurement strategy; integrated logistic support; affordability and life cycle costs, and command control communication and intelligence (C^3I) requirements. Particular emphasis is placed on the requirement for transitioning from development to production.

—**Milestone III.** *Full-Rate Production Decision.* This review decides whether to proceed into the "Full-Rate Production and Initial Deployment" phase. Considerations are: results of completed operational evaluations, threat validation, production or construction costs, affordability and life-cycle costs, production and deployment schedule, reliability, maintainability and integrated logistics support. Other considerations are: producibility, industry surge/mobilization capacity, procurement authorization, personnel training and safety, competition or dual sourcing, and C^3I requirements.

—**Milestone IV,** *Logistics Readiness and Support Review.* This review occurs in the "Operations Support" phase, 1-2 years after initial IOC deployment. This milestone identifies actions and resources needed to ensure operational readiness and support objectives are being achieved and maintained. Considerations are: readiness/sustainability (peacetime and wartime), support objectives, integrated logistics support, disposition of displaced equipment, affordability and life-cycle costs.

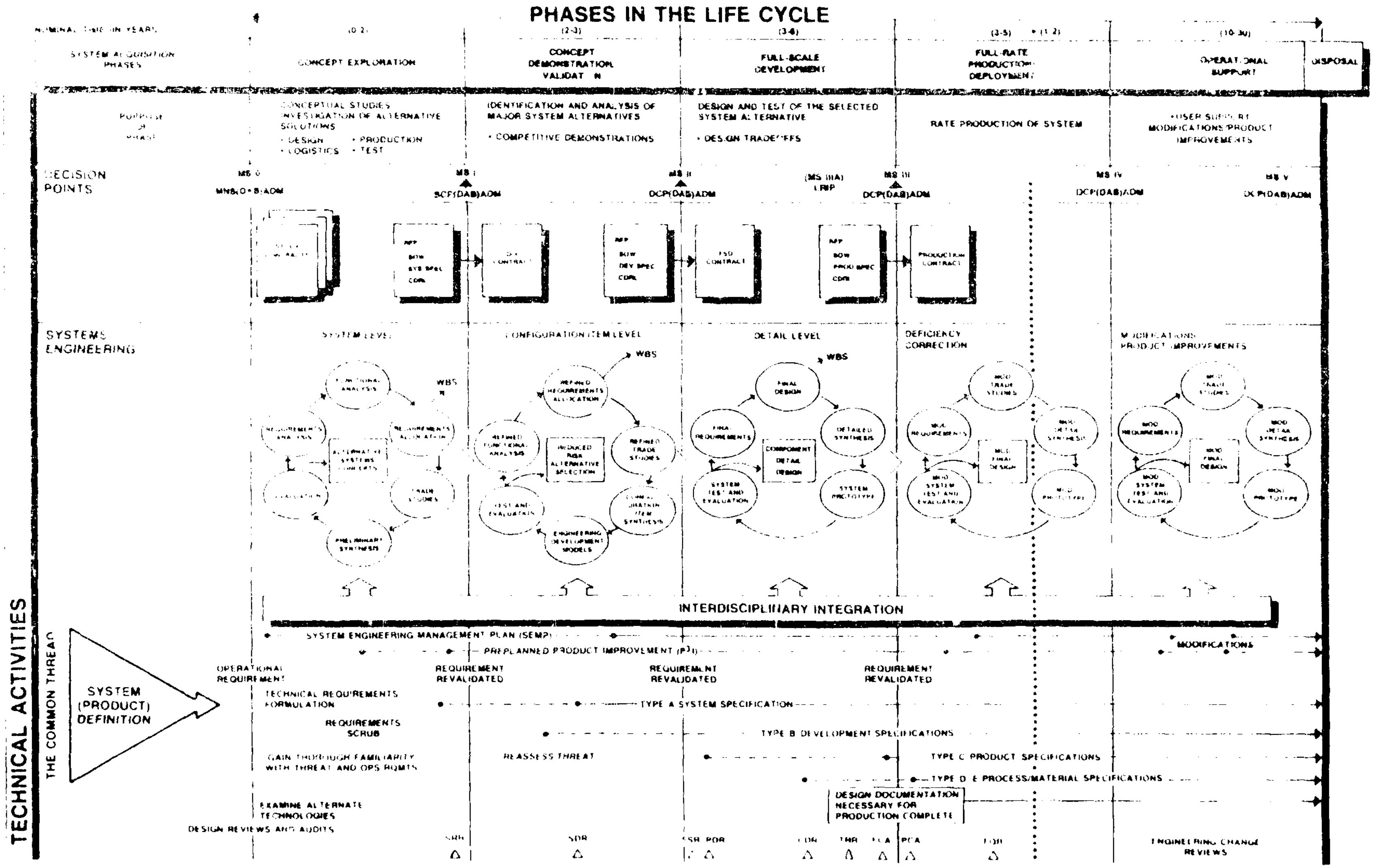
—**Milestone V,** *Major Upgrade or System Replacement Decision.* Normally occurs 5-10 years after initial deployment. Reviews system's current state of operational effectiveness, suitability and readiness. This milestone determines whether major upgrades are necessary. It determines whether or not existing deficiencies warrant consideration of replacement action, major modification, retirement, and/or new start programs. Considerations are: original or evolved mission requirements, modifications that extend useful life, threat changes, technology changes and the disposition of displaced equipment.

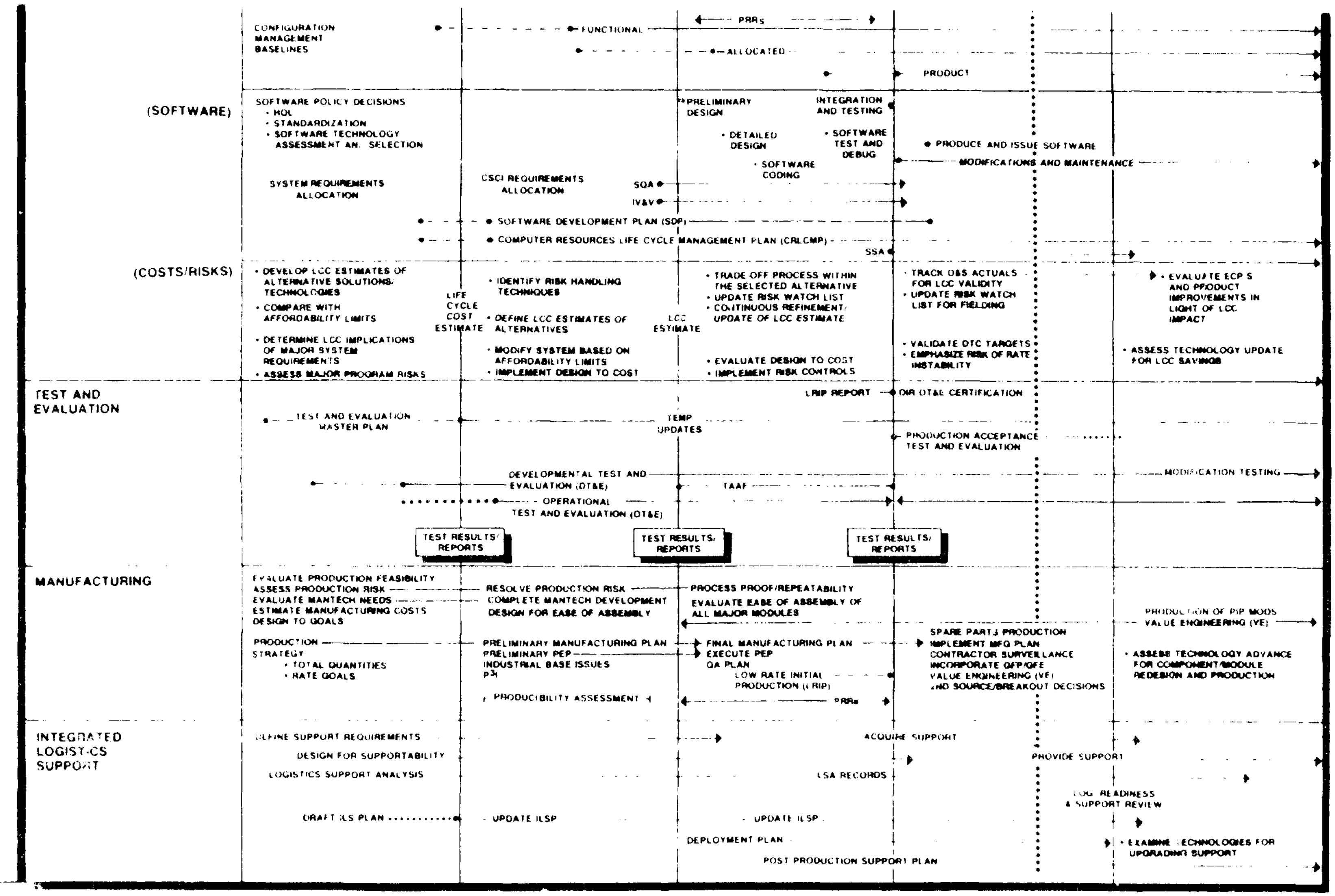
X. SUMMARY

Baselines are the agreed evaluation standards for a program success. They are the benchmarks to plan against and document change directions. Milestones are the events in time when programs are reviewed to check the progress toward achieving their baselines and make decisions to proceed to the next phase of the acquisition cycle.

Attached is the System Life Cycle Chart, SE 1000. It reflects the DODI 5000.1 changes.

SYSTEM LIFE CYCLE TECHNICAL ACTIVITIES





ALL INQUIRIES AND COMMENTS ON THIS CHART SHOULD BE ADDRESSED TO THE TECHNICAL MANAGEMENT DEPARTMENT, DEFENSE SYSTEMS MANAGEMENT COLLEGE, FORT BELVOIR, VIRGINIA 22060-5426

DSMC CHART SE 1 1001
REVISED FEB 1988

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 1.13
Version: Original
Date: February 1989

I. TITLE

Total Quality Management

II. REFERENCES

—Department of Defense Posture on Quality, 30 March 1988

—DOD Total Quality Management Master Plan, August 1988

—*Total Quality Management: A Guide for Implementation*, DOD 5000.51-G (DRAFT) 6 January 1989

—1989 Application Guidelines — Malcolm Baldrige National Quality Award

III. POINTS OF CONTACT

—Mr. Jack Strickland
Director for Industrial Productivity and Quality
OASD (P&L) TQM
Washington, D.C. 20301-8000
(202) 697-6329; AV 227-6329

IV. PURPOSE AND SCOPE

The purpose of this fact sheet is to:

--Outline the basic principles of Total Quality Management.

—Summarize the requirements for the successful implementation of Total Quality Management.

V. DOD POLICY

—Quality is absolutely vital to our defense, and requires a commitment to continuous improvement by all DOD personnel.

—A quality and productivity-oriented defense industry, with its underlying industrial base, is the key to our ability to maintain a superior level of readiness.

—Sustained emphasis and concern, with respect to high quality and productivity, must be an integral part of DOD daily activities.

—Quality improvement is a key to productivity improvement and must be pursued with the necessary resources to produce tangible benefits.

—Technology, one of our greatest assets, must be used widely to improve continuously the quality of defense systems, equipment and services.

—Emphasis must change from relying on inspection, to designing and building quality into the process and product.

—Quality must be a key element of competition.

—Acquisition strategies must include requirements for continuous improvement of quality and reduced ownership costs.

—Managers and personnel at all levels must take responsibility [illegible] quality of their efforts.

—Competent, dedicated employees make the greatest contributions to quality and productivity. They must be recognized and rewarded accordingly.

—Quality concepts must be ingrained throughout every organization with the proper training at each level, starting with top management.

—Principles of quality improvement must involve all personnel and products, including the generation of products in paper and data form.

VI. DISCUSSION

Total Quality Management (TQM) has evolved during the past 40 years and is based on the works of Dr. Armand Fiegenbaum, Dr. W. E. Deming, Dr. Myron Tribus and Dr. Kaoru Ishikawa.

Total Quality Management is the application of management methods and human resources to control all processes with the objective of achieving continuous improvements in quality. The goal of TQM is to improve the quality of DOD products and services while achieving substantial reductions in the cost of ownership throughout the life cycle of our weapon systems. The objective of TQM is to broaden the concept of quality, focusing on quality much earlier in the system acquisition process, starting with requirements definition.

Under the TQM strategy, we seek a cultural change from defect correction to defect prevention; from quality "inspected" into products to quality designed and built into the process and product; from approval of waivers to conformance to properly defined requirements; from lowest procurement cost to optimum life cycle cost; from emphasis on cost and schedule to emphasis on quality, cost and schedule. The definition of quality is expanded from "conformance to requirements" to "conformance to correctly defined requirements that satisfy user needs." This emphasizes the ultimate goal of quality which is to provide the user with products and services that, throughout their life, meet user need and expectations at a cost that represents the best value. Total Quality Management applies to everyone and to every product and service. Total Quality Management, to be as effective as possible, must be adopted by the government and its industrial contractors and suppliers.

The DOD and industry management must be encouraged to work on continuous process improvement and variability reduction in products and services. Toward this end, appropriate emphasis must be placed on the use of such methodologies as design of experiments, concurrent engineering and statistical process control. The continued use of sound systems engineering design and manufacturing engineering practices as outlined in DOD 4245.7-M and the practice of acquisition streamlining must also continue.

VII. BACKGROUND

The need for a TQM strategy in DOD stems from economic events at the national level. First, the United States faces an accelerating balance of trade deficit that affects most major industries (including aerospace and electronics manufacturers). This deficit exists with most of our trading partners.

Second, U.S. industry and the economy as a whole have suffered from lagging productivity improvement. United States quality expertise was exported to Japan after World War II, contributing in large measure to rebuilding a robust and high-quality Japanese industrial base. Finally, the performance and reputation of U.S. goods and services has decreased simultaneously.

The overall objective of TQM is to bring together all DOD efforts related to quality, reliability and productivity under a well-coordinated Total Quality Management approach. This effort will have the goal of delivering high-quality hardware and software to our soldiers, sailors, airmen and marines. This can only be achieved through a total cultural change in DOD, with respect to continuous improvement.

Distinguishing TQM from other improvement strategies is its emphasis upon:

—Management involvement and management's ultimate responsibility for quality

—Customer satisfaction (internal and external)

—Quality awareness throughout the organization

—Long-term commitment to continuous improvement

—Focus on problem prevention, rather than problem detection

—Organizational discipline to practice new behaviors day after day, forever

—Rigorous analysis of management systems and processes

—Cross-functional orientation and teamwork

—Elimination of non-value adding activities

—Involvement of all employees (participatory management)

—Focus on process rather than product

—Learning and adapting to dynamic changes

—Focus on quality as the fundamental cause of cost reduction and increased productivity.

The basic TQM principles are:

—User Focus. User satisfaction and mission performance are the absolute tests of DOD effectiveness. Although Service members are the ultimate users of DOD products, each and every DOD process also has dependent intermediate users. A thorough understanding of the needs of all users, intermediate or ultimate, not only provides the means for assessing performance, it also helps DOD to focus its future direction and establish its future goals.

—Continuous Process Improvement and Problem Prevention. The primary TQM objective is never-ending improvement of every aspect of DOD's work. This objective is implemented through a structured, disciplined approach that improves all processes. With TQM, emphasis is placed on preventing defects through process improvement rather than discovering them through product inspection and test.

—Innovation in Processes, Products and Services. Making every process and product perform better, more reliably, at lower cost, with fewer operations and fewer people. Innovation may mean new technology or it may simply mean innovative thinking which eliminates non-value-adding operations and eliminating administrative barriers to improvement.

—Total Personnel Involvement (Participatory Management). Because all products and services are produced through processes, process improvement applies to every individual in DOD. The DOD's largest and most valuable investment is in its people. People provide the knowledge and experience on which DOD relies. They are the most essential component in continuous process improvement. Training, team building, and worklife enhancements are important elements in creating an environment in which people can grow, gain experience and capability, and contribute to the national defense on an ever-increasing scale.

The Requirements to Implement TQM are:

—Top-Down Implementation. Total Quality Management must first be implemented by top DOD leadership and flow down as a waterfall. This cascading deployment ensures that DOD leaders understand, practice and teach TQM principles and practices before expecting the same from their subordinates. Leadership must provide proper resources, support and training for their employees.

—Constancy of Purpose. The DOD leadership must develop, communicate and maintain a long-term common purpose, with all DOD personnel working toward this purpose. Consistent goals and objectives provide focus and are realized through practicing continuous improvement and recognizing and rewarding behavior aimed at achieving this purpose.

—Teamwork. Teamwork is essential for continuous improvement. Teamwork and team structure align goals, objectives and thought. Team activities build communication and cooperation, stimulate creative thought and provide an infrastructure supporting TQM practices.

—Commitment and Involvement. Top leadership must ensure DOD's strong, pervasive commitment to continuous improvement. Customer satisfaction and pride in workmanship all flow from an overt dedication to continuous improvement. Acting on recommendations to make positive changes demonstrates commitment to improvement. Top management must be an active participant in the TQM process.

VIII. SUMMARY

Total Quality Management must not be based on slogans and is not a motivational campaign. The end result of TQM is organizational performance and competence. Total Quality Management will not succeed if based solely on good intentions and hard work. It is an organized management philosophy requiring extensive time, skill and resources. Total Quality Management is not a program or project; once started, it continues for the life of the organization. The results of TQM can, therefore, only begin to be measured over the long run. Short-term measures can be misleading and may provide the wrong signals to managers and employees. The true results of TQM are measured simultaneously over years in terms of factors such as lower total costs, more reliable and capable hardware and software and a more capable, more satisfied work force.

INSERT TAB 2

FINANCIAL MANAGEMENT

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Business Management Department
Number: 2.1
Version: Update
Date: November 1988

I. TITLE

The Planning, Programming, and Budgeting System (PPBS)

II. REFERENCES

—DODD 7045.14, The Planning, Programming, and Budgeting System of 22 May 1984

—DODI 7045.7 Implementation of the Planning, Programming, and Budgeting System of 23 May 1984

—DOD 7110-1-M, DOD Budget Guidance Manual

—DOD FY 90-94 Instruction of 7 March 1988

III. POINTS OF CONTACT

Deputy Under Secretary of Defense for Policy
(202) 697-0286; AV 227-0286
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(202) 695-0971; AV 225-0971
((For Programming)

Assistant Secretary of Defense (Comptroller)
(202) 695-3237; AV 225-3237
(For Budgeting)

IV. PURPOSE AND SCOPE

This fact sheet provides information about PPBS, the primary resource management process applicable to all Department of Defense (DOD) Components.

V. DOD POLICY

The purpose of PPBS is to produce a plan, a program, and finally, a budget for the DOD. Throughout the three major phases of planning, programming, and budgeting the Secretary of Defense (SECDEF) will provide centralized policy direction while delegating program development and execution authority and responsibility to the DOD Components. Participatory management shall be used in each phase to achieve the objective of providing operational commanders the best mix of forces, equipment, and support attainable within resource constraints.

VI. INTRODUCTION AND BACKGROUND

Knowledge of the PPBS is essential to understand the DOD acquisition process. Resource allocation reflects policies, and is the process of distributing scarce resources to competing alternative programs. Thus, PPBS, a cyclic process, is a major planning and control process setting forth in terms of dollars the "work plan" of all levels within DOD. This is done by a three-phased process containing three distinct but inter-related phases: planning, programming, and budgeting which has proved to be a reasoned and systematic approach to resource management in the DOD.

Prior to PPBS there was no integrated central process within DOD for systematically consolidating, reviewing, and analyzing service programs. Formal review at the Office, Secretary of Defense (OSD) level usually took place during annual budget reviews. The exercise of management through the appropriation structure which the Congress requires created difficulty in relating budgets to military missions. To overcome this deficiency, in 1961 Defense Secretary McNamara established PPBS.

The PPBS process was, until 1986, an annual cycle resulting in a single year proposed budget. It has

since been changed to a biennial schedule to provide a 2-year budget to the Congress, although the basic preparation and review process is the same. The Congress appropriates only 1 year at a time. A compressed cycle, starting in late November 1987, created a revised FY 89 budget submitted in mid-February 1988. Most observers expect a similar effort in 1989. One result may be informal POM developments in the Services, even though they are not submitted in the off-year. The President submitted an FY 1990/1991 biennial budget to Congress in January 1989.

VII. PLANNING PHASE

The first phase of PPBS, planning, is concerned with determining actions and specifying military force requirements to accomplish a mission (such as anti-submarine warfare). Its functions include collecting intelligence about the military capabilities and political intentions of foreign nations, evaluation of the threat to our national security, developing strategies to meet the threat, and devising force levels to support the strategies. The Central Intelligence Agency (CIA) and the Defense Intelligence Agency (DIA) prepare intelligence estimates for assessing the threat. The major portion of the planning effort to meet such threats is accomplished in the PPB structure by the Joint Chiefs of Staff (JCS), with the help of military planners in the services. This work is found in a sequence of documents including the *Joint Strategic Planning Document (JSPD)* and the *Defense Guidance (DG)*.

The JSPD is based upon intelligence provided by the CIA (responsive to the President) and the DIA (responsive to the JCS and SECDEF). The JSPD contains a concise statement of the national security objective and the basic military strategy and force structure required to attain this objective. It provides specific military appraisals and strategic concepts that are necessary to develop basic military objectives, taking into account the major political, military, economic and technological factors and trends likely to influence our military strategy. It includes force planning guidance that is necessary for the development, employment, and support of military forces to maintain the military strategy. Finaly, the JSPD contains a concise evaluation of military risk associated with the military strategy and the force planning and programming guidance.

The SECDEF reviews the JSPD in the fall and biennially issues a draft DG in August based on an analysis of the JSPD. The Secretary sets forth the current objectives, policies, and general planning guidance for the defense program. This guidance reflects changes in national security objectives or commitments as provided by the President. Comments are solicited from DOD Components, Department of State, National Security Council, and the Office of Management and Budget (OMB). The final DG version is issued in not later than 30 November and reflects the output of the planning phase. It defines the fiscally constrained force structure for meeting national security requirements. Thus, the planning phase can be thought of as ending with a statement of security plans and objectives.

VIII. PROGRAMMING PHASE

The programming phase starts with issuance of the DG. The programming phase establishes the dollars to be allocated and introduces other resource constraints such as manpower. Programming inputs are broken down into the 11 Major Force Programs (MFP); e.g., strategic forces, and general purpose forces. During this phase, JCS and the services determine the constrained mix of man-machine systems that best satisfies the defense posture expressed in the planning documents. This is accomplished in the form of defense components' submission to OSD of the Program Objective Memorandum (POM) in April, and the joint program assessment memorandum (JPAM) by JCS in May.

The POM is developed within fiscal constraints contained in the DG and is the primary means for requesting revisions to the five-year defense program (FYDP). The POM reflects a detailed expression of proposed programs in program element terms, schedules and funding 6 years into the future, and force levels 3 years beyond that. It provides rationale or justification for the force levels and programs proposed based on the needs and strategy developed during the planning phase of PPBS by the JSC, OSD, and military departments. Each POM submission is basically a modification of the approved FYDP updated to reflect current guidance from OSD with 2 fiscal years being added during each cycle.

The JPAM provides a user risk assessment of the composite POM force recommendations, including the views of the JCS on the balance and capabilities of the overall POM force and support levels to execute the approved national military strategy, and on the allocation of scarce resources. The JPAM assists in the preparation of issue books which results from OSD level review of the POMs.

Services' POMs are reviewed in relation to the DG and JSPD. Issue papers are then prepared by the OSD staff, the DOD components and OMB. One-page outlines are prepared on those considered to be major issues which have broad policy, force, program, or resource implications. These issues are sent to the Defense Resources Board (DRB) for review and recommendations. The DRB has responsibility for the management and oversight of all aspects of the entire DOD PPBS process. The SECDEF decisions are recorded in a set of program decision memoranda (PDMs), signed by the Secretary or Deputy Secretary of Defense, and distributed to DOD components and OMB in July. A PDM is issued for each service and is the last step in the programming phase. Upon receipt, major issues are identified by service chiefs, service secretaries and SECDEF, and are subject to further in-depth review.

IX. BUDGETING PHASE

The budget cycle is the third and final phase of PPBS. The budget is developed from the POM as amended by the OSDs programatic review. The programming phase is essentially oriented to fitting forces within a fiscally constrained box; the budget phase is the sanding, polishing, and finishing of the most current year of the box.

The Assistant Secretary of Defense (Comptroller) (ASD(C)) publishes a guidance letter in June or July of each year for the budget estimate submission that establishes ground rules for developing the budget. The services supplement this budget guidance and serve to ensure budget estimates are prepared and submitted, based on the programs as approved in the PDMs, and on economic assumptions related to pay and pricing policies developed by OSD in close coordination with the OMB. The budget estimate is submitted to OSD in September, 12 months before the applicable fiscal year. These budget estimates include the prior, current and 2 budget fiscal years (budget year plus one for programs requiring congressional authorization) in accordance with established procedures outlined in the DOD *Budget Guidance Manual*.

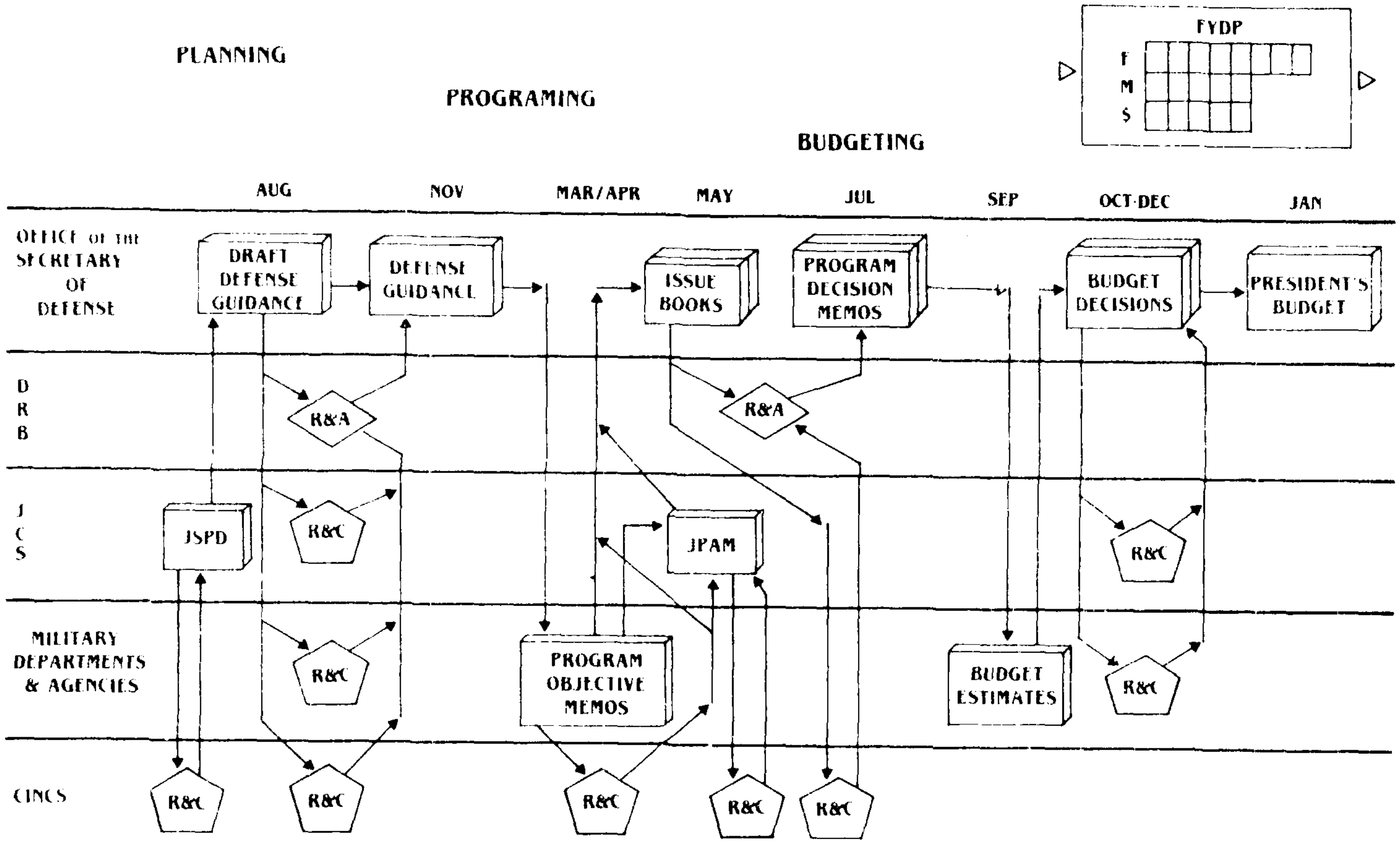
The services prepare budget estimates and submit them to OSD for review. The first year of the POM, as modified by the PDM, is used as a program baseline and all aspects of the program are reviewed in detail. This is done to ensure that the program is executable and properly priced and reflects past congressional actions. Outyears are addressed as they are affected by budget-year decisions. The resulting estimates are forwarded to OSD supported by a variety of summary and detailed budget exhibits, including computer tapes, to update the FYDP. This update is referred to as the October FYDP.

The budget estimate is expressed in appropriation format as opposed to the major force program (MFP) structure used during POM development and review. Use of the MFP structure is internal to DOD. The five primary appropriations used for weapons system acquisition are RDT&E, procurement, operation and maintenance, military personnel, and military construction.

Budget analysts in ASD(C) and OMB conduct a joint review of the budget from October through December. However, OMB retains the authority to submit separate decisions on the reviews. The OSD/OMB reviews are held and appropriate service functional staff provide information as necessary. The entire budget is reviewed to assess conformity with the PDM and other guidance. Cost factors, reasonableness of projections, the timing of related events, and uniformity of approach to items which affect more than one appropriation are reviewed. Program Budget decisions (PBDs) are the decision documents signed by the SECDEF or DEPSECDEF and are used to adjust budgets submitted by the services. The PBDs are related to the appropriations and budget activity structure and include the current year, the budget year, and an estimate of the resource impact on the four succeeding program years.

After coordination with concerned OSD staff elements, draft PBDs are provided to the services. During the coordination process, alternative positions may be prepared by any of these offices. Systems acquisition alternatives, if any, are usually

Figure 1. PLANNING, PROGRAMMING, AND BUDGETING SCHEDULE



DRB	Defense Resources Board
CINCS	Commanders-in-Chief
JLRSA	Joint Long Range Strategic Appraisal
JSPD	Joint Strategic Planning Document
JPAM	Joint Program Assessment Memorandum

R&A — Review and Adjust

R&C — Review and Comment

FYDP SYMBOLS

F Forces

M Manpower

$ Dollars

□ Years

developed by D/PA&E or USDR&E. The PBDs developed by the ASD(C), along with alternative positions, are forwarded to DEPSECDEF for decision and signature. The ASD(C) may sign out those with no staff dissents or alternatives. Specific procedures will vary with the individual holding the office and with the administration. Once signed, a deadline is specified for the service's reclama. The reclama allows the Service Secretary an opportunity to disagree with the PBDs recommendation and provide supplemental information for reconsideration. Reclamas are evaluated in OSD, and decisions are communicated to the services through revised PBDs, one for each reclama. The services reclama most PBDs; however, the majority are not successful. The PBDs become final if not appealed.

After initial review of budget decisions, the services have one last opportunity to identify issues that are serious enough to warrant a *major budget issue* meeting between the Service Secretary and SECDEF. Decisions resulting from these meetings are announced in revisions to issued PBDs.

The services prepare budget schedules supporting decisions resulting from the budget process for inclusion in the President's Budget (which becomes the January FYDP, thereby establishing a consistent base for the ensuing decision cycle.

X. FIVE-YEAR DEFENSE PROGRAM (FYDP)

The FYDP records, summarizes, and displays decisions that have been approved by SECDEF through the PPBS process. It is a management tool that keeps management informed of what has been accomplished in the past and what is to be accomplished in the future. It covers funding and forces for prior, current, and succeeding 5 fiscal years, and force levels for an additional 3 years. Guidance for the 92-97 POM states that the FYDP will cover 6 years, but has not yet changed the name. The FYDP is a compilation of programs identified by program elements that permit the conversion of program costs to the budget, and vice versa. It is published three times a year following the POM submission in May, the budget estimate submission in September, and the President's Budget in January.

XI. THE PPBS AND THE ACQUISITION REVIEW PROCESS

Major acquisition "new starts" at MS 0 are considered concurrently with the OSD POM review. A Mission Needs Statement providing the justification for the program is submitted to the DAE with or before POM submission in which funds are requested. The DAE approves the program with the ADM and issues a program element number (PE) in coordination with the OSD Comptroller. Funding is provided through the POM/budget process with documentation provided in the PBDs. Assuming congressional concurrence, the new program is underway. It is at a MS 0 new start that the systems acquisition review process (DAB) and the POM process (DRB) are coincident.

XII. SUMMARY

The PPBS is shown graphically (Figure 1) in terms of schedule, major documents, and participants. The PPBS has had a significant and positive impact in resource management in the DOD, and program managers (PMs) are involved/impacted by each step of the process. Thus, it is essential that all PMs have a full understanding and appreciation of the system, for it is only through those who implement PPBS can resources be obtained to carry out the defense mission.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Authors: DSMC, Technical Management Department

Number 2.2
Version: Update
Date: November 1988

I. TITLE

Life-Cycle Cost Plan (LCCP)

II. REFERENCES

—DODD 4245.3, "Design to Cost," 6 April 1983

—DODD 5000.1, "Major and Non-Major Defense Acquisition Programs," 1 September 1987

—DODI 5000.2, "Defense Acquisition Program Procedures," 1 September 1987

—DODI 5000.33, "Uniform Budget/Cost Terms and Definitions," 15 August 1977

—Joint Design to Cost Guide—Life-Cycle Cost as a Design Parameter (DARCOM 700-6, NAVMAT P5242, AFLCP/AFSCP 800-19)

—*System Engineering Management Guide*, Defense Systems Management College, Chapter 17

—Technical Report, "An Appraisal of Models Used in Life-Cycle Estimation for United States Air Force Aircraft Systems," DTIC, Defense Logistics Agency, October 1978

—Earles, M. Eddins, *Factors, Formulas, and Structures for the Life Cycle Costing*, 2nd Edition, 1981

—Seldon, M. Robert, *Life-Cycle Costing: A Better Method of Government Procurement* (Boulder, Colorado: Westview Press, 1979)

III. POINTS OF CONTACT

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AV 858-4556

U.S. Army/AMC
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U.S. Navy/Opr (DTC/LCC)
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IV. PURPOSE AND SCOPE

This fact sheet is designed to provide an overview of Life-Cycle Cost (LCC) and to identify LCC planning considerations and reference materials.

V. DOD POLICY

The DOD Directive 5000.1 outlines the basic acquisition strategy for major systems and requires that affordability (in the form of cost estimates) be reviewed at each milestone. DODD 5000.1 also specifies that "cost parameters shall be established that consider the cost of acquisition and ownership." Discrete cost elements (e.g., unit production cost, operating and support cost) be translated into "Design to Cost" requirements. DODI 5000.2 emphasizes that systems be economical to operate and support, specifies an LCC estimate for Mission Need Statement (MNS), when a concept has been selected, and requires a summary of LCC for each alternative concept/system considered, (Annex E to the system concept paper (SCP) and decision coordinating paper (DCP)). DODD 4245.3 established LCC as a design parameter during design

and development phases and as a cost discipline to be employed throughout the acquisition of a system.

The DODD 4245.3 is the principal policy statement on LCC. It establishes "cost as a parameter equal in importance with technical requirements and schedules." It approaches LCC as a philosophy and a goal. The philosophy is one of managing LCC. The goal is to define a developing system's average unit flyaway cost and key operating and support cost drivers for cost containment with "visibility in parallel with LCC." The average unit flyaway cost is established/approved by the secretary of defense (SECDEF) for major programs and at least one level above the program manager (PM) for non-major programs. The goals for flyaway and operations and support (O&S) parameters must be established prior to entering full-scale development (FSD), but earlier definition is encouraged. Unit acquisition and operating and support costs must be specified NLT the DAB II milestone (preferrably by DAB I). Exemption from this requirement for a major program can only be granted by SECDEF when he is convinced that national security interests warrant priority over cost goals.

VI. DEFINITIONS

—**Life-Cycle Cost**. The total cost to the government of acquisition, ownership, and disposal of a system over its full life.

—**Average Unit Flyaway Cost (AUFC)**. The cost of procuring the basic unit, average changes allowance, cost allocated to the basic unit, propulsion equipment, electronics armament, other installed government furnished equipment (GFE), and non-recurring production costs; sailaway or rollaway for sea and ground systems, respectively.

—**Design to Cost (DTC)**. A DOD concept that establishes cost as a parameter equal in importance to technical parameters and schedule; requires that a system be built/designed within specific cost goals both for average unit flyaway cost and operating and support cost parameters.

—**LCC Analysis**. The structured study of LCC estimates and elements to identify life-cycle cost drivers, total cost to the government, cost-risk items, and cost-effective changes; a systems engineering tool with application to all elements of the total system.

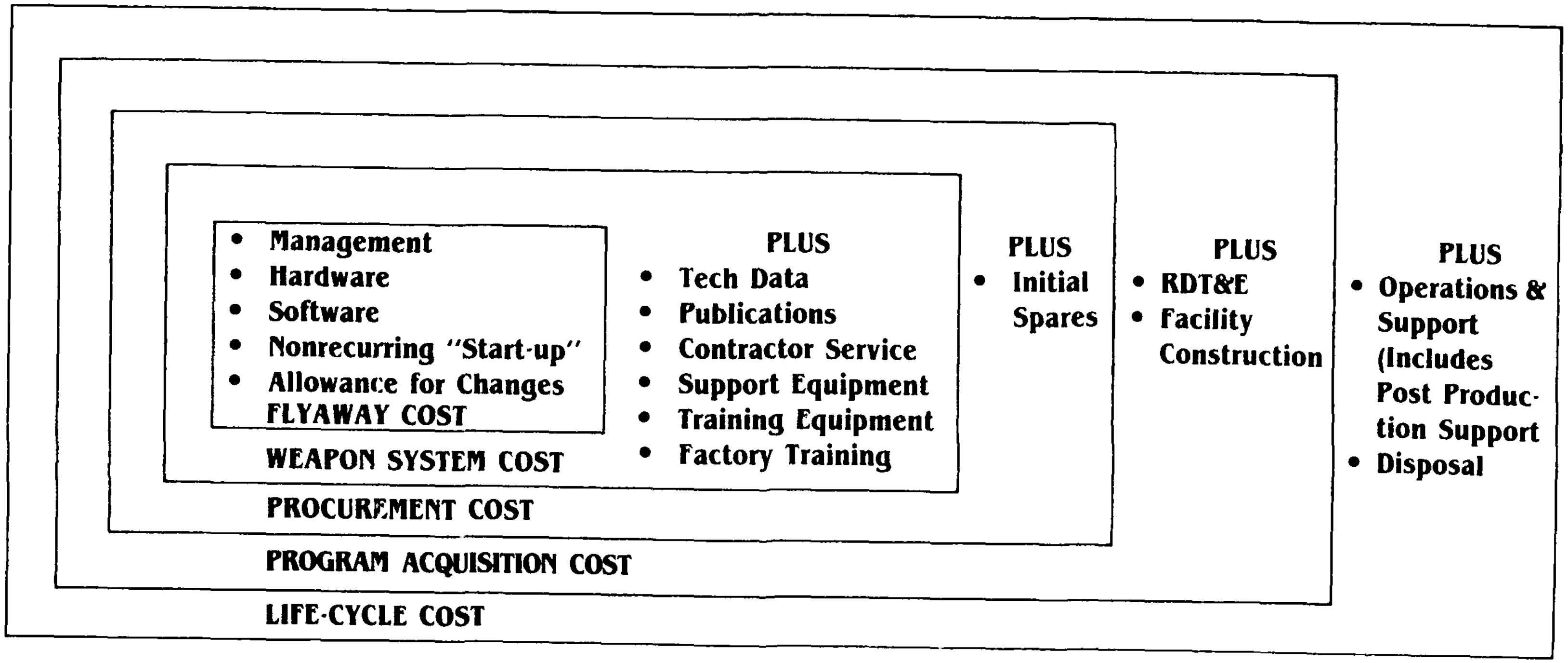
VII. LIFE-CYCLE COST

Figure 1 shows the system cost components that compose LCC. Design to cost is a subset of the LCC concept. Historically, a low initial acquisition cost for hardware has not assured a low LCC. In fact, the opposite is true. The bulk of LCC is usually in O&S costs. Although the military budget has remained relatively flat (in constant dollars) during the past 30 years, O&S costs have grown during that period at a rate greater than 3 percent per year (constant dollars). As a percentage of gross national product (GNP), the military budget has steadily declined.

The two most critical issues in the LCC area are its use as a control function throughout the life of the system/program, and identification of cost drivers in a system/program. Both tasks can be addressed by the using computer models or manual models. The above referenced technical report evaluates several Air Force computer models for aviation systems. The Seldon book offers models/calculations, and formulas (cost estimating relationships) appropriate to each phase of the acquisition cycle. Many computer models are available, but no single model finds favor with everyone. The Defense Systems Management College (DSMC) has available a model that can be run on a personal computer (PC): LCC model, "CASA" (with a risk model).

Models are a key tool in LCC analysis. It is through LCC analysis that we identify and evaluate cost drivers. Cost drivers are parameters that drive O&S costs such as reliability, maintainability, spare parts, and support equipment, just to name a few. The actual list will vary with the system being analyzed. Cost drivers are areas where resources can best be applied to achieve the maximum cost benefit. For example, a reduction in manpower requirements would have a significant impact on a system's LCC. This could be in the form of fewer operators or less expert support personnel requirements. An effective LCC analysis will identify areas where contract incentives may be applied to earn the greatest payoff. An appropriate model for LCC analysis will allow you to input decision variables that would be appropriately weighted in

Figure 1. LIFE-CYCLE COST COMPOSITION



processing and then generate data to aid in decision-making.

The *Joint Design to Cost Guide* (May 1985) is being revised. The current guide states that DTC/LCC should be applied early in the development cycle, because the area of greatest potential impact is requirements generation. Seldon, in *Life Cycle Costing: A Better Method of Government Procurement*, recommends that the LCC effort start as early as possible. Just prior to FSD, the greatest contribution of DTC/LCC is to provide information upon which to base decisions for alternative concepts and designs. Per the guide, application of cost goals in FSD is mandatory, since that is the last point when the design can be significantly influenced by cost. The average unit flyaway cost becomes a firm DTC goal after Milestone II, with O&S parameters identified for cost containment.

During the concept exploration/definition phase, the LCC effort is focused on identifying cost drivers, evaluating relative cost differences among competing concepts, and developing the estimate(s) for the SCP for Milestone I. During the concept demonstration/validation phase, the LCC emphasis is on developing and justifying a firm DTC goal for each alternative. DTC goals for O&S parameters should be established for all elements of future LCC that are design-controllable. These goals, such as mean-time-between-failures (MTBF), should be measurable in some finite terms, if not dollars. The goals must be difficult but achievable. During FSD, a LCC baseline cost estimate must be developed, and it is in this phase that LCC begins its transition from primarily a design element to a control element for the program. All decisions should be considered in the light of LCC impact, but LCC is now more of a control tool for keeping the program on track by highlighting the effect decisions/changes will have on total program cost. Major reviews may be conducted to track DTC/LCC programs between major milestones. Beware! Any number you commit to paper is likely to become *the* estimate and become engraved in stone. Be honest, be fair, be conservative, and, most importantly, be careful!

VIII. LIFE-CYCLE COST PLAN (LCCP)

The above referenced *System Engineering Management Guide* (SEMG) refers to the LCCP as a life-cycle cost management plan and recommends that it address the following issues:

—statement of the contractor's LCC management objective(s) and a description of supporting tasks, milestones, and responsibilities;

—program structure, policies, procedures, and functional interrelationships for maintaining LCC visibillity and control;

—method(s) for determining and identifying LCC drivers and issues subject to trade studies (trade-off-analysis);

—preliminary list of the 10 most influential contract requirements that affect the LCC of the system (e.g., performance, schedules, standards, specifications;

—description of planned analysis methods and DTC/LCC modeling techniques to be used in LCC analysis;

—management approach for integrating subcontractors' efforts into LCC management efforts;

—recommended LCC/DTC goals and planned allocation procedures;

—planned feedback mechanism for tracking and supporting cost-related design goals and status, including proposed analysis and test and evaluation efforts to be used as progress checks.

The above issues correspond quite well to the questions that Seldon suggests each program manager (PM) consider in LCC planning.

—On what ground rules and assumptions should the analysis be based?

—Which estimating procedure will be used?

—What kind of product is the LCC analysis to produce, for whom, in what format, and for what purpose?

—How will buyer (government) and seller (contractor) managements audit and control the LCC process?

—How will the LCC effort be organized and financed?

The SEMG addresses only the concepts of costing procedures and LCC modeling, but Seldon's book provides models for the development of LCC estimates for each phase of the development cycle that are useful in cost-benefit and cost-effectiveness studies. Some of the areas in which these models or estimates may be useful include long-range planning and budgeting, comparison of competing systems, decisions about replacement

of aging equipment, control over an on-going program, and selecting among competing contractors. Although the SEMG offers no tools, it does emphasize that it is very "important that the total LCC be identified and budgeted so that the required level of readiness can be maintained." The LCCP provides the guidance for the LCC analysis which forms the basis for selecting DTC goal(s). The importance of LCC analysis beginning in CE/D and continuing throughout the life cycle is further emphasized when one considers that 95 percent of a system eventual LCC is committed by the end of FSD.

It appears that much effort is concentrated in the areas of logistics analysis and financial cost estimating. If the responsibility for the LCC effort is assigned outside of these two areas, very close coordination must be effected among the LCC team, the logistics element, and the business management element. Seldon points out that an effective LCC effort requires many disciplines such as accounting, contracting, estimating, management, quality control, statistical analysis, engineering, maintainability, manufacturing engineering, and reliability. Some of this effort can be contracted. The contractor's LCC estimate can serve as the baseline for the program.

MIL-STD-499A requires that the contractor submit a DTC/LCC Report as Part I of the LCC Management Plan. This report is described in Data Item Description DI-F-30203. The SEMG suggests that the following elements be part of the contractor's required LCC estimate:

—Purpose and scope
—System and program description summary
—Program schedule summary
—Ground rules and assumptions
—Estimate summaries for RDT&E, production, and operating and support costs
—Rank ordered list of system/components/software which account for 80 percent or more of total estimated system life-cycle cost (ESLCC)
—RDT&E estimate by WBS and function
—Operations and support costs by WBS and function
—Time-phased program costs
—Funding spreads
—Inflation methodology and indexes
—LCC estimate tracking method
—Sensitivity analysis
—Risk and uncertainty analysis.

Methodology is the main ingredient of any LCC documentation package. To be able to evaluate the data, there must be adequate documentation that provides the data and sources for the estimate, estimating method applied to the data, and results of the analysis.

IX. SUMMARY

—Projected defense budget levels and rising costs of acquiring, operating, and supporting defense systems and equipment have created the need to make cost a principal design parameter.
—Although a program may have only a single *monetary* DTC goal (average unit flyaway cost), it is intended that the PM divide that goal into cost elements of acquisition and support parameters controlled by him to suit the structure of his individual program. (DODD 4245.3)
—DTC must be tailored to fit the individual program based on stated objective(s) and risks involved. (*Joint Design to Cost Guide*)
—The "design to" approach will specifically include LCC to the greatest extent possible. (DODD 4245.3)
—The LCCP (plan) provides necessary guidance for the task of analysis which identifies the cost drivers. (Seldon)
—LCC planning and analysis should begin as early as possible in the development cycle (preferably during CE).
—Guidance for developing LCC estimates and conducting LCC analysis is available in the cited references to include some LCC models and modelling techniques.
—LCC analysis must be a principal component of program control.

Author: DSMC, Business Management Department
Number 2.3
Version: Update
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FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

I. TITLE

Cost Estimating Methodologies

II. REFERENCES

—"Cost Considerations in Systems Analysis," Gene H. Fisher, Rand Report R-490-ASD, December 1970

—"Military Equipment Cost Analysis," Rand Report, June 1971

—DODD 5000.4, "OSD Cost Analysis Improvement Group," October 30, 1980

—AFSCM 173-1, "Cost Analysis, Cost Estimating Procedures," April 17, 1972

—DA Pamphlet 11-2, Research and Development Cost Guide for Army Materiel Systems

—DSMC Fact Sheet Number 6.11.1, "Software Cost Estimating"

III. POINTS OF CONTACT

Cost Analysis Improvement Group
Deputy Director for Resource Analysis
OSD Director Program Analysis and Evaluation
(202) 695-0721 AV 225-0721

IV. PURPOSE AND SCOPE

This fact sheet is designed to:
—Describe various cost estimating methods used by DOD and their applicability
—Explain uncertainty and limitations of each method
—Explain uncertainty and risk assessment of a program cost estimate

V. POLICY

There are few specific policy documents at OSD level that give guidance on the subject of cost estimating methodologies.

VI. DEFINITION

—A cost estimate is an evaluation of future cost of an object or service.
—There are four major cost estimating methodologies discussed in this paper: (1) analogy, (2) parametric or statistical, (3) extrapolation from actuals, and (4) engineering.

VII. DISCUSSION

Analogy Method—One Like System

1. The analogy method compares a new subsystem with an existing subsystem or system for which we have accurate cost and technological data. Consider an estimate of the cost of a new 1986 car based on what you paid for your last new car in 1977. This analogy method requires that the estimator make a subjective evaluation relative to the similarities between the system of interest, (new car), and some historic system (old 1977 car). In the above example, you can assume a one-for-one, or totally similar relationship between the old and new car. The uncertainty associated with this technique is based on the subjective nature of the evaluation of the similarities between the two systems. Normally, engineers are asked to make the technical evaluation relative to the system differences. Based on that evaluation, the cost estimator then assesses the cost impact. For example, assume the engineer evaluated that the new car was 30 percent more complex than the old car, due to added electronic systems. Also, assume the

cost analyst found that electronic systems have continually dropped in cost (5 percent per year). If the cost analyst assumed that the cost was directly proportional to complexity, he would then relate 30 percent complexity as a 30 percent increase in cost over the old car. Additionally, the 5 percent cost drop per year for electronic systems would relate over the 7-year difference in cars, to a 35 percent drop in the electronic systems cost. Therefore, a $5,600 old car weighted to reflect the added complexity would yield a cost of (.30) × (.65) × (5,600) + 5,600 = $6,692 for the new car based on 1977 year dollars. To make the estimate current in "now" dollars, assuming a 7 percent rate of inflation over the 7 years, we would have to increase our $6,692 by multiplying it by 1.07, then that answer by 1.07 and so on 7 times.

2. Uncertainty in an analogy cost estimate is due to the subjective evaluations made by the technical staff and cost estimators. In most cases actual technical comparisons can be made. The problem is to develop a cost relationship based on technical differences. Even if all determinations made by the technical staff are quantified and objectively evaluated, the cost estimators need to determine the cost impact associated with the technical findings. These cost impacts are, in most cases, very subjective. Thus, the total uncertainty of the estimate can be quite large.

3. One does not have to use only one analogous system to compare with the system of interest. As an example, you may estimate the cost of a radar system by finding a separate analog for the transmitter, exciter, antenna, processor, etc. The key is that you make a single, pair-wise comparison for each system or subsystem evaluation. The sum of the parts may involve many single analogous cost estimates.

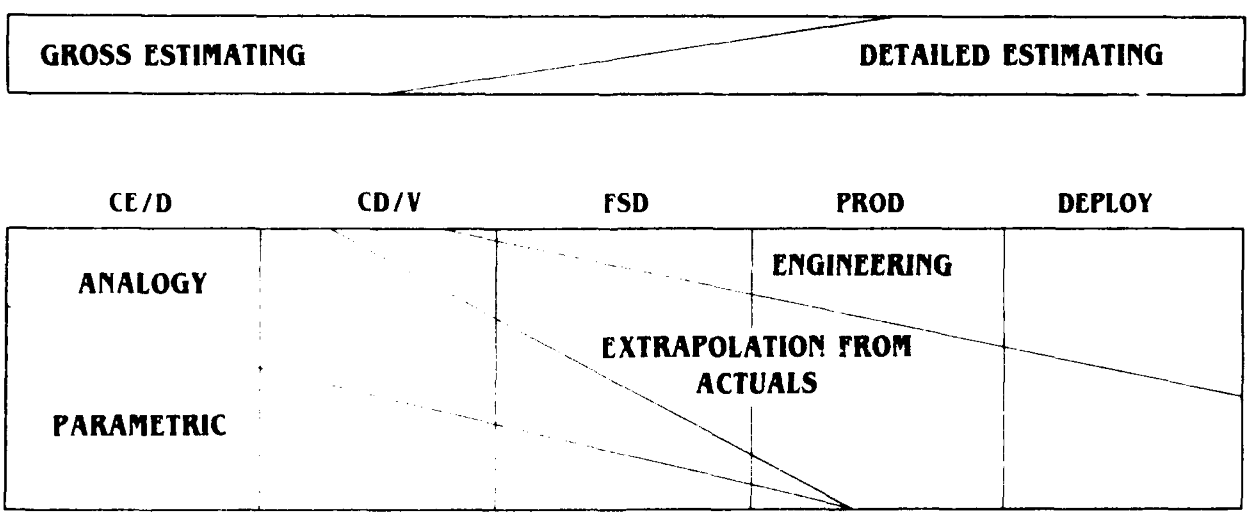
4. The analogous method is most appropriate early in the program acquisition phase when actual cost data for the system, or a large data base of like systems, are not available. This assumes an available analogous system for comparative evaluation (Figure 1).

Parametric Method—Multiple Like Systems

1. The parametric or statistical method is probably most widely used in government and industry because it can yield a multitude of quantifiable measures of merit and quality; i.e., probability of success, level of risk. (An illustration of this method is contained in the PM Fact Sheet on Software Cost Estimating, Number 2.5). Additionally, the parametric method can easily accommodate changes in design, performance, and programmatic characteristics.

2. This method uses a data base of like elements and generates an estimate based on some selected system performance or design characteristic(s). This assumes that there is a relationship between some performance parameter such as speed, weight, thrust (independent variables) and the system cost (dependent variable).

Figure 1. COST ESTIMATING



3. The most important requirement in parametric cost estimating is a good data base. The data base must meet certain criteria. It should reflect like technology to the system of interest (in terms of design, manufacturing/assembly, material, etc.). Technology enhancements that are not reflected in the data base, but which are embodied in the system of interest, will lead to erroneous cost estimates. Attempting to estimate the cost of a current day computer (electronic memory) using a data base of older computers (core memory) would yield a much higher cost estimate than a current system would warrant. The data base has to be timely, containing the latest data available. The technology involved may not only be related to the hardware itself, as in the core versus electronic memory example above, but may be affected by manufacturing technology. For example, the use of automatic insertion equipment instead of hand insertion of components into printed circuit boards (PCB), leads to major reduction in the labor content of PCB assembly.

4. The data base must be homogenous. Each like element in the data base must consist of the same components and be reduced consistently. In other words, in a rocket motor data base where there is an element called the "motor weight" each entry should consist of the same components, measured in the same way. For example, does each element contain the casing, liner, nozzle, hardback, etc., and are all weights in pounds? Homogeneity is very important and is most often missing from current available data bases. The lack of homogeneity can cause significant variances in cost estimates and result in a complete lack of credibility (apples vs. oranges syndrome).

5. The parametric estimating technique is most useful early in the program life (Figure 1), especially when a detailed design specification is not available, but a performance specification is, along with a data base of like systems. Additionally, the parametric technique is very useful as a checking estimate to compare against an estimate made using another technique.

Extrapolation Method—Prior Same System

1. The extrapolation from actuals technique is based on previous data on earlier units of the same system. This is probably the most accurate cost estimating method when feasible (Figure 1). It is the preferred method of the Office of the Secretary of Defense, Cost Analysis Improvement Group (OSD, CAIG), since it uses actual data for the system of interest. The uncertainty associated with this method is based, as with the analog method, on the technical assessment of the differences between the prior system and the current model under consideration, and the implied cost implications of those technical differences.

2. In most cases, as long as there is actual cost data, the extrapolation method will yield a better estimate than any other method. This is because the prior system is more like the current model than any other historic system. Obviously, the closer the two systems are alike, the less uncertainty; the further along a system is in the acquisition process, the more easily an accurate estimate can be made.

3. When comparing a prototype to production models, adjustments are more likely required to compensate for the changes in the manufacturing and assembly methods. In many cases, prototypes are made in engineering model shops by high-grade engineering technicians and the production units are made on a production line by semi-skilled workers. Additionally, prototypes are made in small numbers as compared to the greater quantities in rate production. These differences, however can be factored into the cost estimate using historical company information, not only for like units, but for the system of interest. Additionally, company historic data for other systems helps indentify anomalies in assumptions that are not supported in their current proposal.

Engineering Method—Piece by Piece

1. The engineering, "grass roots," or "bottoms up" estimate is generally the most detailed and, usually, most costly technique to prepare. The engineering method involves the examination and definition of separate work elements at the lowest level of detail of the work breakdown structure (WBS) and the subsequent summation and multiplicative factorings for non-estimated elements, such as quality assurance, system engineering, etc. In other words, the estimator starts at the lowest level of identifiable work with the engineering drawings and specifications, identifies each labor task, tools, production operations, and materials required to accomplish the work.

General factors are then added based on the direct labor material estimated. The individual items are then added together forming the "bottoms-up" estimate.

2. Technique(s) used in discrete work element estimates may be any one of the techniques available. As an example, the estimator may use an analog for a like element of work, a parametric cost estimate from a company or general industry data base of like work elements, or an extrapolation from previous units of the same thing. Or, the estimator may use a set of work standards based on work activities such as milling .002 inches from a 6 inch diameter rod, 3 inches long.

3. The greatest uncertainty in this type of cost estimate is due to the effect of the added multiplicative factors on the small estimated direct labor base. The compounding effect can result in a large error at the summation of the estimated elements. The uncertainty is trackable, and can be calculated; however, this is not a trivial task for a large project.

4. By definition, standards are attainable values for specific work under given conditions. This makes the engineering estimate a great tool for the manufacturer, since it is a means to control work on the floor (process control). This technique has great value and accuracy once the hardware is in production and the design has stabilized. (Figure 1)

VIII. RELATED PROBLEMS

1. The new-car estimate example is indicative of problems associated with cost estimating in general. It should be apparent that inflation is a major factor in cost estimating. If, in our estimate of the new car's cost, we did not account for inflation, we would incorrectly arrive at $6,692 as an estimate for our new car by just accounting for electronic complexity and decreasing technology cost per year. Seven years of inflation at 7 percent accounts for approximately $4,000. When compared to the base cost of $6,692, the inflation cost of $4,000 is significant.

2. No matter how well the analyst does the job of cost estimating, there is always the definitional problem; defining terms and values. In the car example, we considered inflation, effectively making our estimate a current year dollar estimate. If, however, when the estimate was presented we did not define our cost as current year, we would not know *what* type of dollars to budget. The lack of clear definitions in estimating has been the source of major debate, which only spell disaster for the analyst and the program manager.

IX. SUMMARY

1. Of the four cost estimating methods discussed, the extrapolation method is probably the most supportable, but more difficult to accomplish early in the acquisition program.

2. The analogy method is useful early on in the program, when a data base of not more than a few like systems is available.

3. The engineering estimate is the most costly to accomplish and usually provides the greatest uncertainty early in the program. It does, however, require the contractor to do homework and ensures an understanding of the scope of work. Also, it provides a means of controlling the work on the production floor.

4. The parametric technique is most useful early in the program if a data base of sufficient size is available. It provides the easiest and most straightforward uncertainty computation.

5. In all cases, no matter what estimating technique is used, the program manager must ensure that the estimate is fully defendable with rationale and definitions completely documented.

6. Figure 1 summarizes the appropriate techniques available through the acquisition cycle.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Business Management Department
Number: 2.4
Version: Update
Date: November 1988

I. TITLE

Cost/Schedule Control Systems Criteria (C/SCSC): An Overview

II. REFERENCES

—DOD Instruction 7000.2, "Performance Measurement for Selected Acquisitions," June 10, 1977
—DOD Instruction 7000.10, "Contract Cost Performance, Funds Status and Cost/Schedule Status Report," December 3, 1979
—AFSC/AFCC/AFLC P173-5, AMC-P 715-5, NAVSO P3627, DLAH 8400.2, DCAA P7641.47 "Cost/Schedule Control Systems Criteria Joint Implementation Guide," October 1, 1987
—MIL-STD-881A, "Work Breakdown Structures for Defense Material Items," April 25, 1975
—DI-F-6000C Cost Performance Report (CPR)
—DI-F-6010A Cost/Schedule Status Report (C/SSR)
—FAR 52.234-7000, "Notice of Cost/Schedule Control Systems"
—FAR 52.234-7001, "Cost/Schedule Control Systems"

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IV. PURPOSE

This fact sheet is designed to:
—Provide an overview description of the Cost/Schedule Control Systems Criteria (C/SCSC) in use by the DOD
—Explain the managerial usefulness of these criteria as applied to DOD acquisition contracts which exceed certain dollar thresholds.

V. C/SCSC OBJECTIVES

The objectives of C/SCSC are twofold:

—For contractors to use effective internal cost and schedule management control systems
—To provide the government with timely and auditable data produced by those systems for determining product-oriented contract status.

The C/SCSC are not a management control or an accounting system. Because organizations, products, and working relationships vary, it is not feasible to prescribe a universal system for cost and schedule controls. Therefore, the DOD adopted an approach to identify general criteria that contractor management control systems must meet.

The criteria are intended to be general enough to allow their use in evaluating development, construction and production contracts. Since these contracts differ significantly, it is unwise to specify detailed guidance applicable in every circumstance. Use of the criteria must be based upon common sense and practical interpretations that maintain the capabilities for adequate performance measurement.

Uniform implementation of the criteria will avoid imposing multiple cost and schedule systems on contractors. Application of management control systems acceptable to the government and contractor (to contracts at a given contractor's facility) will provide a common source of information for all management levels.

VI. DOD REQUIREMENTS AND GUIDELINES

The DOD 7000.2, first issued in 1967, requires that on major contracts, contractors use management control systems that comply with the C/SCSC. Major contracts are defined jointly by the military departments as: $40 million or more or R&D or $160 million or greater for procurement; and subcontracts that exceed $25 million for R&D or $60 million for procurement. This dollar amount is expressed in current/then-year figures and includes the "full" planned value of the contract including options.

The C/SCSC will not be construed as requiring the use of specific systems or changes in accounting systems that will adversely affect: the equitable distribution of cost to all contracts, or compliance with the standards, rules and regulations issued by the Cost Accounting Standards Board. Further, it is not intended to affect the basis on which contract funding or cost reimbursements are paid.

The contractor's management control system must provide data that:

—Relate time phased budgets to specific contract tasks and/or statements of work

—Indicate work progress

—Properly relate cost, schedule and technical accomplishment

—Are valid, timely and auditable

—Supply managers with information at a practicable level of summarization

—Be derived from the same internal management control systems used by the contractor to manage the contract.

The C/SCSC improves on the budget vs. actuals (spend plan) management technique by requiring that work progress be quantified through "earned value," an objective measure of how much work has been accomplished on the contract. The C/SCSC requires the contractor to plan, budget and schedule authorized effort in time-phased increments that form a performance measurement baseline (time-phased budget). As work is accomplished, the earned value concept allows comparisons to be made against the plan which identifies schedule and cost variances. Key terms used within the C/SCSC include:

—Budgeted Cost for Work Performed (BCWP). The sum of the budgets for completed work packages and completed portions of open work packages, plus the appropriate portion of the budgets for level of effort and apportioned effort that have been completed as of a particular time. This is also known as Earned Value.

—Budgeted Cost for Work Scheduled (BCWS). The sum of the budgets for all work (packages, planning packages, etc.) scheduled to be accomplished (including in-process work packages), plus the amount of level of effort and apportioned effort scheduled to be done within a given time period.

—Actual Cost of Work Performed (ACWP). Costs actually incurred and recorded in accomplishing the work performed within a given time period.

—Budget at Completion (BAC). The total budget amount planned for the contract and/or for each smaller specific task or work breakdown structure (WBS) element.

—Estimate at Completion (EAC). The actual costs to date plus the estimate for authorized work remaining. This includes direct and indirect costs.

The schedule variance (SV) compares the amount of work accomplished (earned value) to the amount scheduled to be done; i.e., a difference from the plan expressed in budget ($) terms. Likewise, a comparison of earned value against the actual costs generated to do the work provides a measure of the cost variance; i.e., the amount of cost under or overrun from the plan for the work accomplished. Planned or scheduled value of work, earned value, and the actual cost of work performed provide an objective measure of performance, thus

enabling a performance trend analysis to be done and cost estimates at completion to be developed at various levels of the contract.

In addition to emphasizing the concept of earned value, the C/SCSC requires thorough integrated contract planning, realistic baseline establishment and control, performance information to be segregated by both product and performing organization, and that measurement of accomplishment at relatively low levels within the contract be summarized and provided to higher management.

VII. DESCRIPTION

There are 35 criteria divided into the following five major sections:

—**Organization.** This section focuses on the definition of work required to be performed by the contractor and the assignment of tasks to organizations responsible for performing the work.

—**Planning and Budgeting.** All authorized work must be scheduled and budgets assigned to identified manageable units of effort on the contract. The assignment of budgets to scheduled segments produces a time-phased plan against which actual performance can be compared. Necessary changes to this plan may be made, but must be rigorously controlled and documented.

—**Accounting.** The system in use by the contractor must be capable of adequately recording all direct and indirect costs applicable to the contract. These costs must be summarized directly from the level at which they are applied to the contract through the work breakdown and functional organization structures.

—**Analysis.** The C/SCSC set forth the characteristics which contractor systems must possess and specify the five basic data elements to be derived—ACWP, BCWS, BCWP, BAC and EAC. Contractor managers are to use these data to determine actual contract status.

—**Revisions.** The contractor's capability to conduct revisions to plans required either by contractual change or internal conditions are examined under this criterion section. Either situation, scope change or internal replanning of activities within scope, must be accomplished in a disciplined manner and maintain the validity of the performance measurement baseline.

VIII. RELATIONSHIP TO CONTRACTUAL SCHEDULES

The C/SCSC performance measurement baseline represents the contractor's internal work plan, the dollarized time-phased schedule for performing the contract. This internal plan generally provides some cushion or slack calendar time with respect to the contract deliveries/milestones and anticipates typical problems such as late vendor deliveries and/or the time required for rework of materials. If not understood, setback schedules can cause confusion because negative (unfavorable) schedule variance may not affect contract delivery if the cushion/slack period can absorb the delay. Schedule variance is expressed interms of the dollars worth of work ahead or behind the plan and must be analyzed in conjunction with other schedule information such as networks, Gantt, and line-of-balance charts. By itself, the C/SCSC schedule variance reveals no "critical path" information and may be misleading because unfavorable accomplishment in some contract WBS areas may be offset by favorable accomplishment in other areas.

IX. IMPLEMENTATION

Implementation of C/SCSC begins with the provision for this requirement being placed in the request for proposal (RFP) provided to industry using FAR 52.234-7000, Notice of Cost/Schedule Control Systems. The offeror's proposal is then evaluated in terms of its ability to meet the criteria. The contractor either offers to use a previously accepted system or to make changes in the existing system to attain compliance with the criteria. The negotiated contract will contain FAR 52.234.7001, Cost/Schedule Control Systems.

When the contract is awarded to a contractor that has not previously demonstrated an acceptable management control system, the contractor's system is reviewed by the government to ensure that it meets the criteria. Successful demonstration of the contractor's management control system generally results in a tri-Service (Army, Air Force and Navy) acceptance that remains in effect as long as the system continues to meet the criteria. In the case above, wherein the contrac

tor had a previously accepted management control system and proposed to use it on the contract, the government performs a subsequent application review (SAR). The purpose of the SAR is to determine whether the contractor is properly and effectively using an accepted system for the new contract. It is not a redemonstration of the previously accepted system.

Typical points of contention between the government and industry concerning C/SCSC implementation include: time required to implement, levels designated for management and reporting, variance thresholds, and system discipline requirements. These sensitive areas can affect the cost of implementing and operating a C/SCSC compliant system. The cost of C/SCSC, sometime alleged to be excessive, has defied quantification because it is virtually impossible to separate the incremental C/SCSC cost from management cost that would have been incurred in any case. However, there is no dispute that improper implementation and excessive reporting requirements imposes an unnecessary burden and additional costs on the contract. Knowledgeable C/SCSC personnel should be consulted during the preparation of the RFP, the data call and during negotiations.

X. REPORTING

There are no explicit external reporting requirements in the C/SCSC. The criteria require that contractors have and use effective internal control systems. Summary data from the internal systems are reported to the government through Cost Performance Report (CPR) as specified on the Contract Data Requirements List. The CPR and the Cost/Schedule Status Report, normally used for smaller contracts that do not require compliance with C/SCSC, are fully described in "Performance Measurement Reports," Fact Sheet 2.4.1.

XI. CONCLUSION

The C/SCSC are the best tool available to ensure contractors have and use adequate cost and schedule management control systems. It provides better overall planning and control discipline on defense contracts. The associated reports summarize objective data from the contractor's internal system for contractor and government managers to use. Improvements in contract management can be achieved by management attention to developing and using good cost and schedule management control systems and taking timely actions when problems are identified from the data generated.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Business Management Department
Number: 2.4.1
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Date: January 1989

I. TITLE

Performance Measurement Reports: Cost Performance Report (CPR) and the Cost/Schedule Status Report (C/SSR)

II. REFERENCES

—DOD Instruction 7000.2, "Performance Measurement for Selected Acquisitions," June 10, 1977
—DOD Instruction 7000.10, "Contract Cost Performance, Funds Status and Cost/Schedule Status Report," December 3, 1979
—AFSC/AFCC/AFLC P173-5, AMC-P 715-5, NAVSO P3627, DLAH 8400.Z., DCAA P7641.47, "Cost/Schedule Control Systems Criteria Joint Implementation Guide," October 1, 1987
—DARCOM-P 715-13, NAVMAT P5244, AFLCP 173-2, AFSCP 173-3, DLAH 8315.3, "Cost/Schedule Management of Non-Major Contracts (C/SSR Joint Guide)," 1 November 1978
—MIL-STD-881A, "Work Breakdown Structures for Defense Material Items," April 25, 1975
—DI-F-6000C Cost Performance Report (CPR)
—DI-F-6010A Cost/Schedule Status Report (C/SSR)

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IV. PURPOSE

This fact sheet is designed to:
—Provide a description of the two types of performance measurement reports used within the DOD
—Identify the similarities and differences between the reports.
—Identify the performance data elements required for analysis.

V. PERFORMANCE REPORTING

In order for the government managers to obtain information from the contractor regarding cost, schedule and technical performance, two types of reporting documents have been developed—Cost Performance Report (CPR) and Cost/Schedule Status Report (C/SSR).

The CPR is generally used to obtain performance data in conjunction with the application of the Cost/Schedule Control Systems Criteria to a fixed-price incentive or cost-reimbursable contract which meets the threshold of either $40 million for R&D or $160 for procurement. The C/SSR is intended for application to contracts over $2 million but less than the $40 or $160 million described above, are longer than 12 months duration, and have not been

selected for a CPR. Only one of these reports *will be* applied to a single contract.

VI. PERFORMANCE DATA ELEMENTS

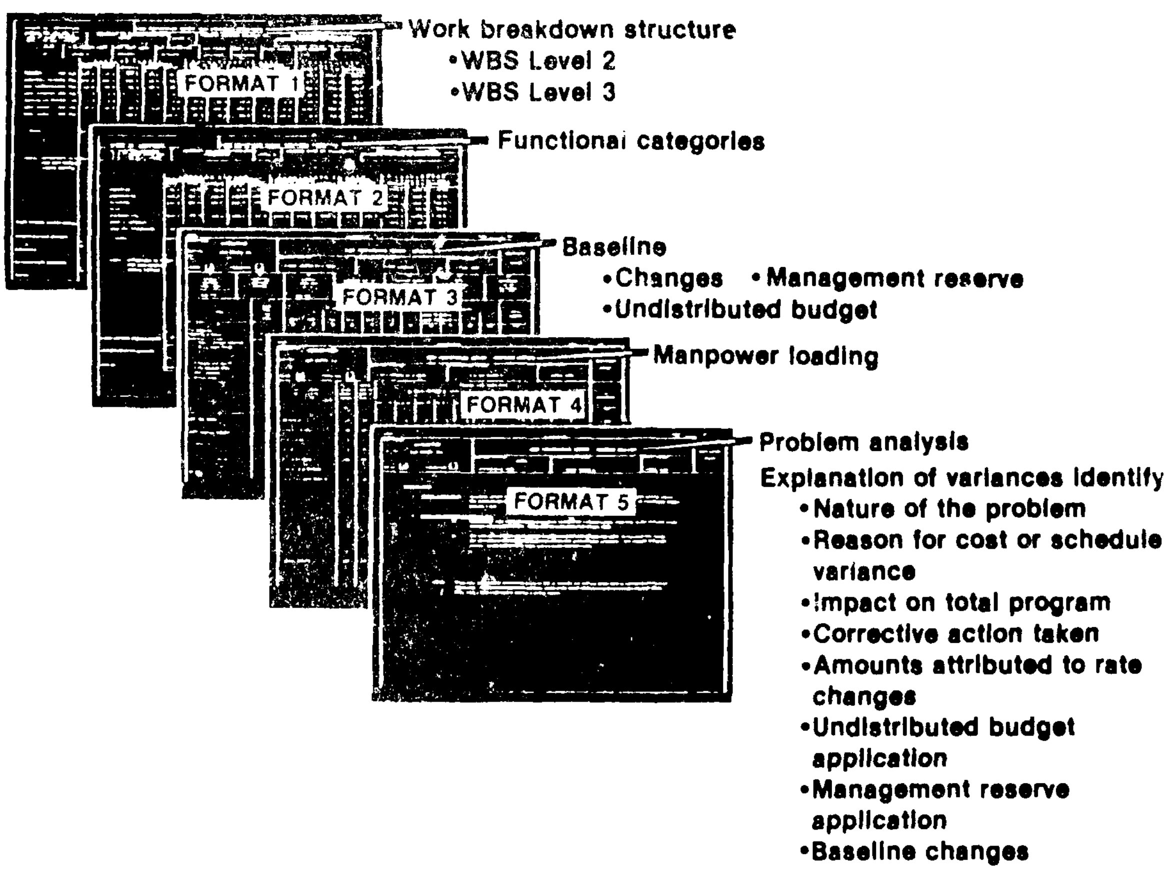
The CPR and C/SSR contain the same basic data elements from the contractor's internal management control system. The common data elements are budgeted cost of work scheduled (BCWS); budgeted cost of work performed (BCWP), also called "earned value"; actual cost of work performed (ACWP); budget at completion (BAC); latest revised estimate (LRE) of cost at completion; and the amount of management reserve retained by the contractor. Comparison of data elements BCWS, BCWP and ACWP allows the contractor to calculate and report cost and schedule variances which show the differences between the work plan, actual work status, and actual costs to date. The differences in methodology used to generate these data for these two reports are significant and shall be described in the following sections.

VII. COST PERFORMANCE REPORT (CPR)

The contractor is required to use data from his/her existing (government accepted) management control systems in making CPRs for DOD components. Application of the C/SCSC clauses in solicitation and the negotiated contract is not a requirement for delivery of data. These data requirements are specified in the contract in the Contract Data Requirements List (CDRL) using DD Form 1423.

The CPR contains five separate formats and is the most detailed performance report sought by the government manager (see Figure 1). The CPR is described in the latest revision of data item DI-F-6000 (C as of this writing). The report contents specified in each contract should be tailored by the DOD customer to meet his/her management needs. Parameters established during negotiations include the report frequency, report due date, contract work breakdown structure (CWBS) level of reporting and variance threshold values.

Figure 1. DODI 7000.10 COST PERFORMANCE REPORT



Format 1. This format provides both current (most recent accounting period) and cumulative (start of contract through last period) performance data elements segregated by contractor CWBS. Schedule or cost variances which exceed negotiated dollar thresholds at various CWBS levels require a narrative explanation on Format 5 (see Figure 2.).

Format 2. Contract effort segregated by functional organization is presented on this format. The bottom line contract totals equal those on Format 1. It is the same contract data sliced from a different viewpoint. Functional organization performance data are displayed in exactly the same way as are the CWBS elements showing: current period, cumulative data, BAC and LRE values. Significant functional variances may also require explanation on Format 5 (See Figure 3).

Format 3. The time-phased dollarized budgets are displayed for: current period, cumulative value to date, the next six (6) months and for five (5) additional specified periods which take the contract to completion. Changes to future period budgets, application of management reserve, and distribution of undistributed budget (UB), if applicable are identified here. Further explanations/reasons for these actions are provided on Format 5 (see Figure 4).

Format 4. Manpower projections for those functional organizations listed on Format 2 are shown here. Presented are data representing: current period, cumulative to date, the next 6 months and 5 specified periods extending to contract completion. These data allow managers to compare the remaining work on the contract to other projected manpower mix planned to accomplish it (see Figure 5).

Format 5. The problem analysis format addresses: the overall contract status, significant schedule and cost variances that result from data analysis differences between planned and actual achieveents, reasons for baseline changes, use of management reserve with rationale and any other contractual subject requiring management visibility. The information explains both what has happened; i.e., history that created the current status and the actions being taken to solve problems, implement work arounds, conduct replanning of future activities and identify associated costs (see Figure 6).

Benefits of obtaining the CPR to the program office include: reporting objective performance status, cost impacts of known problems, identification of emerging problems, capability to trace probems to their source (organizational and CWBS), and the quantification of schedule deviation in dollars from the contract plan. The report serves as a mechanism to provide both government and contractor program managers with essential objective data and provides a sound basis for decision-making.

VIII. COST/SCHEDULE STATUS REPORT (C/SSR)

This report is also acquired by use of the CDRL on a contract. The data item used to obtain this report is the latest version of DI-F-6010 (currently A). The C/SSR was designed for use on particular lower dollar contracts, over $2 million but below the C/SCSC thresholds. This does not require government validation of the contractor's management control system. The government does not evaluate or accept the management control system and it offers the contractor maximum flexibility in the management of the contract. The assumption is that the contractor's system is adequate.

The report contains only two formats, as compared with the five formats of the CPR. It provides a format similar to Format 1 of the CPR but contains only cumulative data for CWBS elements (see Figure 7). The second is the problem analysis presentation, similar to CPR Format 5. The report does not contain organizational, baseline or manpower projection data.

Since the contractor's system does not undergo a formal government acceptance and retains flexibility for determining techniques to schedule and status work accomplished, the reported data are considered to be reasonably objective. If changes in his/her management control system are desired, they must be negotiated as part of the contract.

The benefits to the program office of using the C/SSR are similar to those obtained from the CPR, but only as long as the DOD customer fully understands the contractor's management control system. Of key interest to the customer are the methods of scheduling work and claiming earned value for work accomplished.

IX. USE OF PERFORMANCE DATA

The CPR and C/SSR provide similar cumulative data elements to management for analysis. Schedule and cost variances can be easily identified from these data and appropriate management attention can be devoted to specific areas of the contract. Schedule variances identify CWBS elements in which work is either ahead or behind the budgetary schedule. Management concerns include: why is work behind schedule; what specific tasks are involved; are these tasks on the critical path; and are there resources to recover schedule, if necessary? Cost variances are shown for areas where costs are higher or lower than planned for the work actually completed. Management concerns include: which tasks are causing the variances; why are these costs high or low; will these costs be controlled in future tasks? "Earned value" accomplishments can be compared to technical performance milestone accomplishments to reconcile the business and technical aspects of contract status. Data elements may be compared by formulae to generate indices of schedule and cost performance efficiency. These performance indices may, in turn, then be applied to the amount of remaining work on the contract to generate a new estimate at completion (EAC) for each CWBS element or at the total contract level. In the case of CPR Format 2, these analyses may be conducted on each functional organization as well. Comparison of these calculated estimates, to those reported by the contractor, often highlight areas worthy of management attention and discussion.

It should be noted, however, that neither the CPR or C/SSR were designed to be real time substitutes for active program management. The greatest utility from these reports is obtained by using them to: provide a framework for statusing performance on each CWPS of the contract, and perform trend analysis for quantifying past and future performance. It is recommended that each PM take advantage of available automated analysis techniques. This could include obtaining tabular performance data via electronic transmission or computer diskette as early as possible after each accounting period, selecting an appropriate software/hardware computer package to assist in data analysis, and formally defining the process (internal to the PMO for utilizing cost performance information.

No program manager should wait for the CPR to alert him/her to a problem. Problem alert should come from the industry program manager and the CPR provides confirmation and quantification. The CPRs are slow to arrive in the program management office!

The CPRs tend to be more useful and timely, now that they can be provided on a disk.

The CAPPS program allows the program manager/program management office to perform in-depth CPR analysis. In fact, the program manager can use the latest CPR and CAPPS disks on almost any personal computer to provide a status briefing.

X. CONCLUSION

The three additional data formats in the CPR make it much more comprehensive than the C/SSR. However, intelligent use and practical application of either report can significantly assist the program manager to accomplish the mission. Both reports provide objective status from the contractor's internal management control system within a mutually understood CWBS framework to support management actions.

Figure 2. COST PERFORMANCE REPORT — WORK BREAKDOWN STRUCTURE

CLASSIFICATION

PAGE of

COST PERFORMANCE REPORT — WORK BREAKDOWN STRUCTURE

CONTRACTOR: / LOCATION: / RDT&E PRODUCTION	CONTRACT TYPE/NO:	PROGRAM NAME/NUMBER	REPORT PERIOD	SIGNATURE, TITLE & DATE	FORM APPROVED OMB NUMBER 22R0280

QUANTITY	NEGOTIATED COST	EST COST AUTH. UNPRICED WORK	TGT PROFIT/FEE %	TGT PRICE	EST PRICE	SHARE RATIO	CONTRACT CEILING	EST CONTRACT CEILING
	THE	CONTRACT						

ITEM	CURRENT PERIOD					CUMULATIVE TO DATE					REPROGRAMMING ADJUSTMENTS		AT COMPLETION		
	BUDGETED COST		ACTUAL COST WORK PERFORMED	VARIANCE		BUDGETED COST		ACTUAL COST WORK PERFORMED	VARIANCE						
	WORK SCHEDULED	WORK PERFORMED		SCHEDULE	COST	WORK SCHEDULED	WORK PERFORMED		SCHEDULE	COST	COST VARIANCE	BUDGET	BUDGETED	LATEST REVISED ESTIMATE	VARIANCE
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
WORK BREAKDOWN STRUCTURE	LAST MONTH'S PERFORMANCE					CUM TO DATE PERFORMANCE							FORECAST AT COMPLETION		
COST OF MONEY															
GEN AND ADMIN															
UNDISTRIBUTED BUDGET															
SUBTOTAL															
MANAGEMENT RESERVE															
TOTAL															
	RECONCILIATION TO CONTRACT BUDGET BASE														
VARIANCE ADJUSTMENT															
TOTAL CONTRACT VARIANCE															

DOLLARS IN

Figure 3. COST PERFORMANCE REPORT — FUNCTIONAL CATEGORIES

CLASSIFICATION

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COST PERFORMANCE REPORT — FUNCTIONAL CATEGORIES

CONTRACTOR LOCATION RDT&E PRODUCTION	CONTRACT TYPE/NO.	PROGRAM NAME/NUMBER	REPORT PERIOD	SIGNATURE, TITLE & DATE	FORM APPROVED OMB NUMBER 22R0280

QUANTITY	NEGOTIATED COST	EST COST AUTH. UNPRICED WORK	TGT PROFIT/FEE %	TGT PRICE	EST PRICE	SHARE RATIO	CONTRACT CEILING	EST CONTRACT CEILING

ORGANIZATIONAL OR FUNCTIONAL CATEGORY	CURRENT PERIOD					CUMULATIVE TO DATE					REPROGRAMMING ADJUSTMENTS		AT COMPLETION		
	BUDGETED COST		ACTUAL COST WORK PERFORMED	VARIANCE		BUDGETED COST		ACTUAL COST WORK PERFORMED	VARIANCE		COST VARIANCE	BUDGET	BUDGETED	LATEST REVISED ESTIMATE	VARIANCE
	WORK SCHEDULED	WORK PERFORMED		SCHEDULE	COST	WORK SCHEDULED	WORK PERFORMED		SCHEDULE	COST					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
COST OF MONEY															
GEN AND ADMIN															
UNDISTRIBUTED BUDGET															
SUBTOTAL															
MANAGEMENT RESERVE															
TOTAL															

Figure 4. COST PERFORMANCE REPORT — BASELINE

CLASSIFICATION

PAGE of

COST PERFORMANCE REPORT — BASELINE

CONTRACTOR: LOCATION: RDT&E [ ] PRODUCTION [ ]	CONTRACT TYPE/WO:	PROGRAM NAME/NUMBER	REPORT PERIOD:	FORM APPROVED OMB NUMBER 22R0280

(1) ORIGINAL CONTRACT TARGET COST	(2) NEGOTIATED CONTRACT CHANGES	(3) CURRENT TARGET COST (1) + (2)	(4) ESTIMATED COST OF AUTHORIZED, UNPRICED WORK	(5) CONTRACT BUDGET BASE (3) + (4)	(6) TOTAL ALLOCATED BUDGET	(7) DIFFERENCE (5) - (6) (SEE PAGE 5)

(8) CONTRACT START DATE	(9) CONTRACT DEFINITIZATION DATE	(10) LAST ITEM DELIVERY DATE	(11) CONTRACT COMPLETION DATE	(12) ESTIMATED COMPLETION DATE

ITEM	BCWS CUM TO DATE	BCWS FOR REPORT PERIOD	BUDGETED COST FOR WORK SCHEDULED (NON CUMULATIVE)											UNDIST BUDGET	TOTAL BUDGET
			SIX MONTH FORECAST						(ENTER SPECIFIED PERIODS)						
			+1	+2	+3	+4	+5	+6							
(1) PM BASELINE (BEGINNING OF PERIOD)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(LIST BASELINE AUTHORIZED DURING REPORT CHANGES PERIOD)															
PM BASELINE (END OF PERIOD)															
MANAGEMENT RESERVE															
TOTAL															

CLASSIFICATION

Figure 5. COST PERFORMANCE REPORT — MANPOWER LOADING

CLASSIFICATION

PAGE OF

CONTRACTOR LOCATION RDT&E PRODUCTION	COST PERFORMANCE REPORT - MANPOWER LOADING CONTRACT TYPE/NO.:	PROGRAM NAME/NUMBER:	REPORT PERIOD:	FORM APPROVED OMB NUMBER 22R020

ORGANIZATIONAL OR FUNCTIONAL CATEGORY	ACTUAL CURRENT PERIOD	ACTUAL END OF CURRENT PERIOD (CUM)	FORECAST (NON-CUMULATIVE) SIX MONTH FORECAST BY MONTH	(ENTER NAMES OF MONTHS)					(ENTER SPECIFIED PERIODS)					AT COMPLETION
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
TOTAL DIRECT														

(ALL FIGURES IN WHOLE NUMBERS)

Figure 6. CPR FORMAT 5

CLASSIFICATION

PAGE ____ OF ____

COST PERFORMANCE REPORT — PROBLEM ANALYSIS				
CONTRACTOR: LOCATION RDT&E [ ] PRODUCTION [ ]	CONTRACT TYPE/NO.:	PROGRAM NAME/NUMBER:	REPORT PERIOD:	FORM APPROVED OMB NUMBER 22R0280

EVALUATION

SECTION 1 — TOTAL CONTRACT:

SECTION 2 — COST AND SCHEDULE VARIANCES:

SECTION 3 — OTHER ANALYSIS:

SECTION 4 — OVER-TARGET BASELINE:

CLASSIFICATION

Figure 7. COST/SCHEDULE STATUS REPORT

CONTRACTOR: LOCATION RDT&E PRODUCTION	COST/SCHEDULE STATUS REPORT			SIGNATURE, TITLE & DATE:	FORM APPROVED OMB NUMBER 22R0327
	CONTRACT TYPE/NO:	PROGRAM NAME/NUMBER:	REPORT PERIOD:		

CONTRACT DATA

(1) ORIGINAL CONTRACT TARGET COST	(2) NEGOTIATED CONTRACT CHANGES	(3) CURRENT TARGET COST (1) + (2)	(4) ESTIMATED COST OF AUTHORIZED, UNPRICED WORK	(5) CONTRACT BUDGET BASE (3) + (4)

PERFORMANCE DATA

WORK BREAKDOWN STRUCTURE	CUMULATIVE TO DATE					AT COMPLETION		
	BUDGETED COST		ACTUAL COST WORK PERFORMED	VARIANCE		BUDGETED	LATEST REVISED ESTIMATE	VARIANCE
	WORK SCHEDULED	WORK PERFORMED		SCHEDULE	COST			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
GENERAL AND ADMINISTRATIVE								
UNDISTRIBUTED BUDGET								
MANAGEMENT RESERVE								
TOTAL								

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Business Management Department
Number 2.5
Version: Original/Current
Date: December 1988

I. TITLE

Software Cost Estimating

II. REFERENCES

Boehm, Barry W., *Software Engineering Economics*, Prentice-Hall, Inc., 1981

Rudwick, Bernard H., "Adjusting Software Estimating Models to Obtain Comparative Results," *Journal of Parametrics*, March 1984

Fact Sheet, "Cost Estimating Methodologies," Number 2.3

AFSCM 173-1, "Cost Analysis, Cost Estimating Procedures," 17 April 1972

DA Pamphlet 11-2, "Research and Development Cost Guide for Army Materiel Systems"

DOD Directive 5000.4 "OSD Cost Analysis Improvement Group," 30 October 1980

III. PURPOSE AND SCOPE

This fact sheet is designed to:
—Identify software trends and the importance of software cost estimating to the DOD program manager (PM)

—Describe how a software cost estimate is generated using a popular parametric software cost estimating model as an example.

IV. POLICY

There are few policy documents available on this subject.

V. THE IMPORTANCE OF SOFTWARE COST ESTIMATING AND RELATED TRENDS

With ongoing advances in the development of electronic equipment, hardware costs of information systems have been decreasing rapidly. Thus, program managers are finding that software costs (primarily labor) are a very significant portion of the total life-cycle cost of modern weapon systems. In fact, the upward trend is so pronounced that today hardware is often treated merely as packaging for the software. Software development and maintenance cost as a percentage of total system costs over the last 30 years is shown in Figure 1.

What is perhaps most interesting about Figure 1 is not that software costs are increasing, but that software maintenance costs in recent years have overtaken initial software development costs. This effort is used not only to correct "bugs" (errors), but is needed mainly for subsequent changes and improvements to the software.

The growth in demand for software shown in Figure 1 creates a tremendous challenge for the PM and software engineering professionals on the program management team. The challenge is threefold:

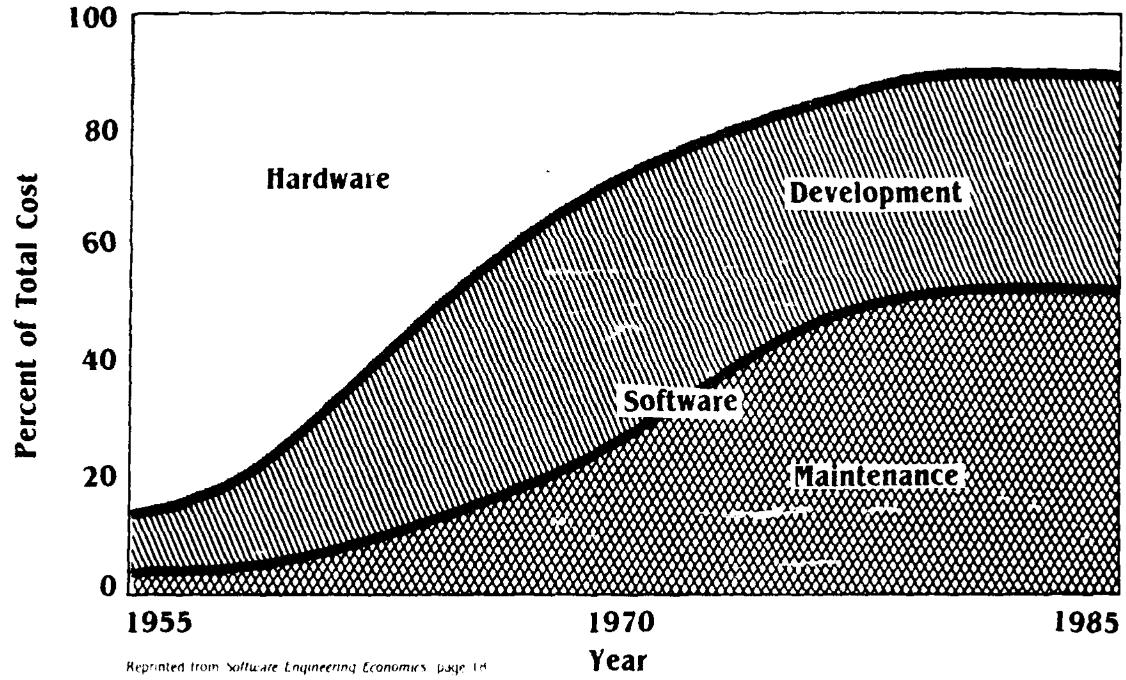
—To increase significantly software development productivity

—To increase efficiency of software maintenance

—To forecast adequately the life-cycle software resources needed to support the program.

—As explained below, understanding the fundamentals of software development and maintenance that underlie the first two parts of the challenge is a necessary prerequisite to meeting the software cost-estimating challenge embodied in the third.

Figure 1. HARDWARE/SOFTWARE COST TRENDS



Reprinted from *Software Engineering Economics*, page 18

One of the first things a PM must do early in the acquisition process, and continue throughout the life cycle, is provide a program cost estimate for higher-level review and program control. The program cost estimate is especially important in the early phases of the life cycle since it is the basis for establishing the funding profile for the program. These early program cost estimates often become "locked in" and are difficult to change in the out-years. Consequently, the better the job done by the PM up-front in cost estimating, the fewer funding problems should occur downstream.

There is a second reason for the PM to know how to generate a software cost estimate. When development or production contracts are to be negotiated, the contractor who proposes the effort submits a cost proposal containing the cost estimate. One method by which a PM can validate a cost estimate submitted to him is to have his cost estimator generate his own cost estimate using his own cost estimating formulas, his available data base of costs and characteristics of related systems, and an appropriate set of technical or performance values describing the system under consideration. This government estimate is then compared to the contractor's estimate. If the two estimates are far apart, further discussions are held with the contractor to clarify the reasons for these differences (in terms of the input values and assumptions made by each of the cost analysts generating the different estimates).

VI. ESTIMATING SOFTWARE COST

Experience has shown that the ability of both government agencies and industrial contractors to estimate software development costs accurately has not been good, and is even inferior to our ability to estimate hardware development costs. There are several reasons for this. First, two prerequisites are required for generating accurate cost estimating relationships. These are: 1) A well defined, disciplined work process which will, in general, be followed, and 2) a uniform, homogeneous data base of historical cost data relating to this work process will be collected. Unfortunately, software development is currently more of an undisciplined art than the more codified hardware engineering design process. Unlike the process of hardware development, no generally agreed upon work process is followed in developing software, either among software development organizations, or even within an organization itself. Without some type of standard work process any historical data collected results in a non-homogenous data base, producing high uncertainty in the cost estimate.

Another reason that the process of developing hardware is so much better under control is that we have realized that it is costly to keep changing the hardware design from its original baseline design. Unfortunately some feel that changing the software design is easier (less costly), and hence allow this to change more readily. Until we come to grips with these considerations we shall have difficulty in forecasting costs accurately.

In spite of these difficulties and the resulting less accurate cost estimates we can generate, it is still necessary to cope with today's conditions and use some method of producing the most accurate cost estimate we can with the data we have available.

A number of mathematical formulas are available today for estimating software cost. These formulas are called cost estimating relationships (CER) or cost models. Most CERs used in industry and government today are parametric models. (See PM Fact Sheet Number 5.2, "Cost Estimating Methodologies," for a further description of parametric cost models). These models generally estimate the system cost (as well as resources required and schedule) as a function of a number of independent variables (cost drivers) called parameters. Examples of these software cost-estimating models are the contructive cost model (COCOMO) developed by Boehm; software life-cycle management model (SLIM); RCA PRICE software cost estimating model (PRICE S); and Jensen JS-1 and 2. Since COCOMO is the only non-proprietary model of the ones cited, and its characteristics are available in the literature (See Ref. 1), this software cost-estimating model will be described in this fact sheet.

In his book, Boehm describes three COCOMO models (basic, intermediate, and detailed). As might be expected, each provides increasing accuracy over its predecessor, but at the cost of additional analytical effort. This fact sheet will concentrate on the intermediate model.

Intermediate COCOMO Model Nominal Estimating Equation

The COCOMO intermediate model consists of two primary components. The first consists of a nominal estimating equation representing software development effort (in project man-months) as a function of the number of delivered source instructions (or lines of code). Obviously the man-months of development effort can be readily converted into labor costs in dollars by multiplying man-months by the fully burdened labor rate per month. A similar equation also is available for schedule time (in months).

The numerical characteristics of these equations depend on which of three different modes of software development is to be used, as depicted in Table 1:

This shows that development effort and schedule are basically a function of the number of delivered source statements.

To select the appropriate COCOMO equation the cost analyst must determine which mode best defines the project being estimated:

Mode	**Project Characteristics**
Organic:	In-house software development and relatively small development teams in a stable environment. Accounting type programs exemplify this category.
Embedded:	Software program operates within tight constraints. Software typically embedded in a complex hardware systems and must often "take up slack" when difficulties are encountered. Most aerospace programs are in this category.
Semidetached:	Contains a mixture of organic and embedded mode characteristics. May contain some rigorous interfaces (tight constraints) and some very flexible interfaces. (The word semidetached comes from this "partial" flexibility.) This category is in between the other two.

Other key definitions and assumptions associated with these equations are:

The primary cost driver is the number of delivered source instructions (KDSI) developed for the project. This term is defined in the COCOMO model as follows:

—*Delivered.* In essence, all software modules designed and developed from scratch or significantly rebuilt are included as delivered software. Generally, this item excludes non-delivered sup-

Table 1. BASIC COCOMO EQUATIONS

Mode	Nominal Man-Months	Schedule Time
Organic	$MM = 3.2\ (KDSI)^{1.05}$	$TDEV = 2.5(MM)^{.38}$
Semidetached	$MM = 3.0\ (KDSI)^{1.12}$	$TDEV = 2.5(MM)^{.35}$
Embedded	$MM = 2.8\ (KDSI)^{1.20}$	$TDEV = 2.5(MM)^{.32}$

Where:

MM = man-months required to develop the software
KDSI = number representing thousands of delivered source instructions (lines of code)
TDEV = time to develop the software in months

port software such as test drivers. However, if these are developed with the same care as delivered software, with their own reviews, test plans, documentation, etc., then they also should be counted.

—*Source Instructions*. The COCOMO defines this term to include all delivered program instructions created by project personnel and processed into machine code by some combination of pre-processors, compilers, and assemblers. It *excludes* comment cards and unmodified software. It *includes* job control language, format statements, and data declarations. Instructions are defined as lines of code or card images. Thus, a line containing two or more source statements counts as one instruction; a five-line data declaration counts as five instructions.

The development period covered by COCOMO cost estimates begins at the beginning of the product design phase (successful completion of a software requirements review) and ends at the end of the integration and test phase (successful completion of a software acceptance review). Costs and schedules of other phases are estimated separately.

The COCOMO cost estimates cover specific activities that are indicated on the typical software work breakdown structure (WBS). For example, the development estimate covers management and documentation efforts, but excludes some efforts that take place during the development period, such as user training, installation planning, and conversion planning.

The COCOMO cost estimates cover all direct labor on the project for the activities indicated in the WBS. Thus, they include program managers and program librarians, but exclude computer center operators, secretaries, higher management, janitors, etc.

While these are the definitions Boehm used in generating COCOMO, as long as the COCOMO model is calibrated to the contractor's method of operation any consistent definition of source instructions and these other factors may be used.

COCOMO Development Effort Multipliers

Selecting the appropriate mode and using the COCOMO equations with KDSI as the independent variable will give a very rough cost estimate. To improve the estimate, the Intermediate COCOMO model uses 15 other cost-driver attributes, which are assigned values and factored in as multipliers to the basic equations. These cost drivers are presented in Table 2 along with associated numerical multiplier values. (The Boehm reference has tables that provide criteria and assistance in assigning a value to each of the 15 cost drivers).

For example, what is the required software reliability? As shown in Table 2, six categories of reliability are defined, from very low to extra high. If the required reliability is very low, only 75 percent of the normal development effort (from the basic equation) will be required. On the other hand, if the required reliability is very high, 140 percent of the normal development effort will be required. In a similar fashion, if the analyst capability is very low, 146 percent of normal effort is required. Whereas, if the analyst capability will be very high, only 71 percent of normal development effort is required.

VII. CALIBRATING THE COCOMO MODEL

How can the COCOMO model be made to correspond to another organization's method of operation?

Table 2. SOFTWARE DEVELOPMENT EFFORT MULTIPLIERS

	Ratings					
Cost Drivers	**Very Low**	**Low**	**Normal**	**High**	**Very High**	**Extra High**
Product Attributes						
RELY Required software reliability	.75	.88	1.00	1.15	1.40	
DATA Data base size		.94	1.00	1.08	1.16	
CPLX Product complexity	.70	.85	1.00	1.15	1.30	1.65
Computer Attributes						
TIME Execution time constraint			1.00	1.11	1.30	1.66
STOR Main storage constraint			1.00	1.06	1.21	1.56
VIRT Virtual machine *		.87	1.00	1.15	1.30	
TURN Computer turnaround time		.87	1.00	1.07	1.15	
Personnel Attributes						
ACAP Analyst capability	1.46	1.19	1.00	.86	.71	
AEXP Applications experience	1.29	1.13	1.00	.91	.82	
PCAP Programmer capability	1.42	1.17	1.00	.86	.70	
VEXP Virtual machine experience*	1.21	1.10	1.00	.90		
LEXP Programming language experience	1.14	1.07	1.00	.95		
Project Attributes						
MODP Use of modern programming practices	1.24	1.10	1.00	.91	.82	
TOOL Use of software tools	1.24	1.10	.91	.83		
SCED Required development schedule	1.23	1.08	1.00	1.04	1.10	

Reprinted from *Software Engineering Economics*, page 118

***For a given software product, the underlying virtual machine is the complex of hardware and software (OS, DBMS, etc.) it calls on to accomplish its tasks.**

All cost-estimating models consist in some way of an extrapolation of some set of *relevant* historical data. The COCOMO equations were constructed from a set of 63 past aerospace projects whose characteristics were available to Boehm and were representative of the way that TRW develops software. Hence, Boehm's equations represents the way that *TRW development teams* may perform in the future. However, another company performing the same 63 projects would be expected to achieve different results than TRW because the work processes and methods of operation of the two companies would not be the same. In addition, another company's method of counting KDIS, man-months, etc., may differ from that of TRW. Thus if COCOMO is to be used by another organization, their cost estimator needs to "fine tune" the model to correspond to the way his organization operates. We call this fine-tuning "calibrating" or "tailoring" the model. Calibration is done as follows: First identify several (the more the better) software development projects that the estimator's organization has completed in the past. These projects should be of the same type as the new project. Gather data on the actual number of delivered lines of code (KDIS), development effort and time, and values of the effort multipliers for each of the past projects. Next, insert this input data for each project into the COCOMO model and calculate the COCOMO cost estimate for each project. Compare the COCOMO cost estimate to the actual completed value. suppose we find that the

average of the true results is 12 percent greater that the average of the COCOMO estimates. One way of adjusting or calibrating the COCOMO model to the contractor's method of operation is by including an additional multiplier factor; in this case, Mc = 1.12. A more scientific method is to use a similar method but use a least-squares approximation technique. This method is described in Boehm's book.

VIII. ACCURACY AND DEALING WITH UNCERTAINTIES

No model can ever predict perfectly the future cost of any system. What COCOMO provides is a "most likely" cost of the software development program. However, the PM also should be aware of the uncertainty surrounding this estimate. There are two forms of uncertainty that effect any cost estimate: the uncertainty in the model itself, and the uncertainty in each of the inputs to the model.

Boehm indicates that the intermediate model "produces results which are within ±20 percent of the projects actuals 68 percent of the time." To the non-statistician this is equivalent to saying that the model is accurate to within ±20 percent (the standard error of estimate is 20 percent).

However, the input values also will have some associated uncertainties, particularly the uncertainty in the number of delivered lines of code. Thus, the cost analyst needs to determine how much the final cost estimate is affected by the uncertainty in the input value of lines of code. Several techniques should be used to accomplish this. First, a software work breakdown structure should be constructed, decomposing the entire software project into software programs or modules of smaller size; e.g., application programs, control programs. Second, since there is some uncertainty in the size of each module, the estimated KDSI of each module should be presented as a three-point estimate (most likely, optimistic, pessimistic) as in PERT analysis. Next, the set of estimates should be reviewed by a group of informed reviewers, the reasons for large differences among the estimates should be discussed, and modifications made as necessary. This uses the Delphi approach to gaining consensus among reviewers. The resulting final estimates that follow the series of review discussions may be converted into a group consensus of the KDSI as follows: The most likely group value of each module is defined as the arithmetic mean of the individual most likely values. The lowest group value is defined as the minimum of all minimum values. And the highest group value is defined as the maximum of the maximum values. Standard PERT calculations are then used to calculate the mean value and range of uncertainty of the entire set of modules. Finally, the mean and the range of uncertainty in the final cost estimate may be obtained by using standard sensitivity analysis.

IX. CONCLUSIONS

In order to meet the challenges of software development and maintenance, the PM must get involved early in the project. One of the first things the PM must do is to have generated a software cost estimate, or independently validate someone else's cost estimate. The COCOMO intermediate cost-estimating model offers an available method to do this. However, it is important to calibrate this model by gathering historical data regarding results of past projects that are related to the project under consideration. By using this approach, and continuing to refine these estimates as additional information is obtained (e.g., newer estimates of KDSI and the effort multipliers as the program progresses), the PM and his software experts will be able to track the program and obtain early warning of problems that may develop.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Business Management Department
Number: 2.6
Version: Update
Date: November 1988

I. TITLE

Indirect Cost Management

II. REFERENCES

—Federal Acquisition Regulation (FAR) Subpart 31
—Cost Accounting Standards (CAS)

III. POINTS OF CONTACT

Air Force:
Headquarters U.S. Air Force
AF/RDC
Directorate Contract Pricing
The Pentagon
Washington, D.C. 20360
(202) 695-9043

Army:
Headquarters AMC
AMCPP-PC
Pricing Branch
Cost/Pricing Policy Division
5001 Eisenhower Ave.
Alexandria, VA 22333-0001
(202) 274-8055

Navy:
Office of the Assistant
Secretary of the Navy
Contract Business Management
Crystal Plaza. Rm 536
Washington, D.C. 20360
(202) 692-8684

Other:
Headquarters Defense Logistics Agency
AFO
Cameron Station
Alexandria, VA. 22314
(202) 274-7611

IV. PURPOSE AND SCOPE

This fact sheet is designed to:
—Define and explain contractor cost accounting for indirect costs
—Define direct versus indirect costs
—Explain the process of indirect costs accumulation and allocation to contracts
—Explain the development and use of forward pricing rates, billing rates, and final rates
—Describe the government role in indirect cost management.

V. POLICY

The government cost regulations are based on the FARPart 31 and the Cost Accounting Standards (CAS). The cost principles and procedures in the FAR apply to contracts, subcontracts, and modifications when the price is negotiated on the basis of analysis of the contractor's costs. The cost principles and practices apply in determining cost reimbursement, negotiation of overhead rates, and other cost determinations or negotiations required by a contract.

The rules governing the applications of cost accounting standards are somewhat complex. In general, unless specifically exempted, a contractor's first negotiated defense contract or subcontract over $500,000 is subject to all CAS standards. Any additional defense negotiated contract of $100,000 or more also is covered. Exemptions from CAS apply to areas such as contracts with small business, sealed-bid awards and contracts with foreign governments.

VI. GENERAL

The issue of cost determination on DOD contracts is important to both the contractor and government. For the contractor, cost data is a substancial part of the information system by which he manages the company. Cost information is critical in pricing, resource allocation, cost control, and performance evaluation. For the government as a customer, the contractor's cost system plays a major role in determining the price of not only cost-reimbursable contracts but also negotiated fixed-price contracts.

The rules in the FAR deal with allowability; that is, which costs can be included in a proposal, billing, or claim applicable to a government contract. These rules do not specify any particular accounting system. The contractor may structure the accounting system to fit his particular operations as long as the system does not violate general requirements. For example, the system must be able to segregate costs by contract line item, must be able to identify costs by categories such as preproduction versus production or as specific disallowances, and must be applied consistently. Contracts subject to CAS must meet somewhat more restrictive systems requirements concerning how costs are allocated to contracts, but the contractor still has considerable latitude in the design of the accounting system. With regard to allocation, the system must assure that a specific cost is only accumulated for allocation to contracts once, and that each contract receives its fair share—but only its fair share of costs.

Cost Allowability

—As indicated above, the FAR deals with allowability; i.e., which costs can be included in a proposal, billing, or claim applicable to a government contract. The factors to be considered in determining whether a cost is allowable include:

(1) Reasonableness
(2) Allocability
(3) CAS, if applicable; otherwise generally accepted accounting principles and practices
(4) Terms of the contract
(5) Limitations established by the FAR subpart 31.2, which discusses selected and specific unallowable costs.

A reasonable cost (FAR 31.201.3) in its nature and amount does not exceed that which would be incurred by a prudent person in the conduct of competitive business. Reasonableness of specific costs is of particular concern in connection with firms or separate divisions that may not be subject to effective competitive constraints. What is reasonable depends upon many considerations and circumstances involving the nature and amount of the cost in question.

Per FAR Subpart 31.201-4, a cost is allocable if it is assignable or chargeable to one or more cost objectives on the basis of relative benefits received or other equitable relationship. Subject to the foregoing, a cost is allocable to a government contract if it:

(a) Is incurred specifically for the contract
(b) Benefits both the contract and other work, and can be distributed to them in reasonable proportion to the benefits received
(c) Is necessary to the overall operation of the business, although a direct relationship to any particular cost objective cannot be shown.

The CAS, if applicable, provides further guidance concerning cost allocation to government contracts while generally accepted accounting principles (GAAP) provide the overall framework for all accounting. Terms of the contract may influence cost allowance by inclusion of special provisions such as a cost sharing agreement. Lastly, cost allowance is influenced by the FAR treatment of a long list of selected costs (FAR 31-205-1 to 31-201-48). These FAR provisions provide guidance on specific costs some of which are allowable as contract costs; e.g., depreciation and material costs, while others are specifically disallowed; e.g., interest and contributions.

Although it is generally not necessary for a PM to know the specifics of accounting rules on the specific disallowances, it is important to understand that a contractor is required to have supporting accounting information for proposals, billings, and reimbursable contracts. The FAR and CAS establish guidance concerning the character of that supporting system, but the contractor has latitude to develop his system within that guidance. The FAR provides further guidance concerning the allowability of costs charged or proposed to the government including specific disallowances of certain types of costs.

The contractor is required to certify, under penalty of perjury, that all costs contained in his/her indirect cost proposals are, to the best of his/her knowledge and belief, allowable under the FAR cost provision and allocable in accordance with CAS requirements.

Direct versus Indirect Costs

Direct costs can be identified with a single-cost objective such as a product or contract. They normally include such items as the subcontracted costs related to that cost objective, material incorporated into the product, and wages of personnel who actually build the product.

Indirect costs include all those that are not direct. They relate to two or more final cost objectives. Indirect costs usually include support-type costs that are required to continue operations, but which are not associated with a single product or contract. Examples generally include items such as the expensed cost of buildings and equipment in which production takes place, cost of indirect labor such as plant security or production control, and cost of fringe benefits such as vacation time and pension costs.

In the government contracting environment, indirect costs are usually divided into two subcategories; overhead and general and administrative (G&A). Overhead costs are indirect costs that support a specific part or function of the company, but not the whole company. For example, maintenance costs of the factory can logically be associated as support costs to the various manufacturing jobs performed in the factory; the cost of the engineering library would logically be associated with the engineering department and not with material handling or the accounting department.

The G&A costs, on the other hand, cannot logically be associated with any particular group of cost objectives, but are required to support the business as a whole. Common examples of G&A costs would typically include salary of the chief executive officer, legal and accounting costs, marketing expenses, independent research and development costs, and bid and proposal costs.

It is important to note that the classification of costs as direct or as overhead or G&A does not hinge on the allowability of the cost related to a government contract. The classification of direct versus indirect has to do with the relationship of the cost to a final cost objective. Overhead and G&A costs are indirect because they are caused by and benefit more than one cost objective. Depreciation on factory machines, usually an indirect cost, is just as necessary as the direct cost of the machine operator. Reasonableness of a cost is determined in terms of what was bought and how much was paid, regardless of whether the spending was a direct or indirect charge.

Accounting for Indirect Costs

As indicated earlier, the accounting system simultaneously provides information supporting the contractor's management needs and the government customer's requirement for fair pricing and payment. To fulfill these information requirements, the accounting system must identify and collect costs and assign those costs appropriately to contractor organizational units, products, and contracts. A main question is: How much cost should be assigned to a specific cost objective? In the case of a direct cost, the answer is relatively straightforward: Assign all of the direct cost to the cost objective that benefits from the cost incurrence. Direct costs are, by definition, costs incurred to perform that cost objective. With indirect costs, however, the assignment or allocation of cost to a cost objective is more difficult.

Many theoretical issues arise concerning accounting for indirect costs. In reality, however, theory often gives way to simplified practical applications. Relatively broad categories of indirect costs are aggregated into "pools," which relate in a common way to a group of cost objectives. Then, an allocation base is selected that determines assignment of the indirect costs in the pool to the individual cost objectives. For example, let us assume that a company decides to aggregate all the indirect costs that support factory operations in a manufacturing overhead pool as follows:

INDIRECT EXPENSES

Indirect Labor	$1,000
Fringe Benefits	$500
Depreciation and Repair	$300
Indirect Operating Expenses	$100
Miscellaneous Expenses	$100
Total Indirect Expenses	$2,000

Now the company must allocate these costs to contracts in accordance with a logical relationship such as the amount of direct labor assigned to each contract; for example, assume there were three contracts that form all of the manufacturing cost objectives. These contracts had manufacturing direct labor charges during the year as follows:

CONTRACT	MANUFACTURING DIRECT LABOR
A	$750
B	$500
C	$250
Total Direct Labor	$1,500

If direct labor cost were considered to be an equitable basis for allocation of indirect cost, the resultant assignment of cost to the contracts would be as follows:

$$\text{Mfg Overhead Rate} = \frac{\text{Mfg indirect expense for the year}}{\text{Mfg direct labor dollars for the year}}$$

$$\text{Rate} = \frac{\$2,000}{\$1,500} =$$ 133% or $1.33 of indirect charge per $1 of direct labor assigned to the contract.

Contract	Direct Labor	x	OH Rate	=	Indirect Mfg Change
A	$750	x	133.3%	=	$1,000
B	$500	x	133.3%	=	$667
C	$250	x	133.3%	=	$333
	$1,500				$2,000

Pool and Base Considerations

The FAR (31-203(b)) indicates that "indirect costs shall be accumulated by logical cost grouping with due consideration of the reasons for incurring such costs. Each group should be determined so as to permit distribution of the groupings on the basis of the benefits according to the several cost objectives." Typically, the structuring of the pools is related to some organizational basis. Commonly, manufacturing overhead, engineering overhead, material handling costs, off-site support costs, and G&A expenses are separately grouped.

The CAS introduced the term "homogeneous costs" to explain which expenses should be aggregated in a single pool. Homogeneity means that the costs pooled together and allocated by a single base have the same or similar relationship to the cost objectives which the indirect functions support. It is important to recognize that the criterion for determining which indirect cost belongs in a given pool is not the relationship of indirect costs to each other. It is determined by the cost objectives and their relationship to the indirect costs or to other cost objectives. It is important to recognize that the number of indirect cost pools will vary from contractor to contractor. Regulations do not specify a certain number of pools. Some smaller contractors have a simple system where a single rate applies all indirect costs to all jobs. On the other hand, most larger contractors require multiple rates in order to properly allocate costs. In general, more cost pools provide more accurate accounting and cost allocation. Smaller pools, however, tend to be more volatile, harder to use for rate predictions, and administratively more costly.

In aggregating indirect costs, we must consider the common denominator that relates those costs to the cost objective. That common denominator is the allocation base. Although regulations do not specifically define an allocation base, the FAR and CAS provide guidance concerning its selection. The FAR (31.203(b)) indicates that the base must be common to all cost objectives to which the pooled costs will be allocated. Also, the selected base must provide for allocation of indirect costs on the basis of benefits received by the cost objectives. Factors commonly used as allocation bases are:

1. Direct labor dollar costs or direct labor hours worked for allocation of manufacturing or engineering overhead
2. Direct material cost to allocate material handling costs
3. Total cost or value added costs for allocation of G&A expenses.

Selection of the pool and base determine how indirect costs are allocated to contracts. Indirect costs represent a large portion of the total costs incurred by most contractors. Consequently, management decisions concerning accounting for indirect costs can have a significant impact on total contract cost. Although a program manager will generally not be expected to deal with the technical accounting matters, he or she should recognize that from the government viewpoint, equity is the dominant criterion for cost allocation.

The Process of Rate Development

Overhead and G&A rates are developed for three specific uses in government contracting. First, rates

are developed for pricing and negotiating new contracts or modifications. These rates are estimates of anticipated future overhead costs. The second primary utilization is the billing rate used by the contractor to obtain reimbursement for costs incurred during the performance of the contract. Third, rates are developed at the conclusion of the contractor's fiscal year to determine the final allowable cost on all cost reimbursement type contracts. The following provides a discussion of each of these three rates, their use and some discussion of the roles of the parties involved.

The forward pricing rates, or bidding rates as they are sometimes called, are projected for each pool in the contractor's cost accounting system and used to develop pricing proposals to be submitted to the government. Because a different rate is applied to the direct work expected in each year of contract performance, forward pricing rates are developed for each company fiscal year for several future years. These rates are developed as a part of the company planning process where the contractor projects detail costs, direct and indirect, that will be incurred in the accomplishment of the projected sales. For the direct cost, the contractor's cost estimating system will provide time-phased cost estimates for each element within direct labor, direct material, and other direct charges. These costs then will be used in a determination of the appropriate base, as discussed in the previous section on allocation.

Indirect costs will be estimated at the cost center level to determine the necessary indirect resources to support the forecasted level of sales. The indirect cost will be estimated for each element of indirect cost, such as real estate taxes or utility costs. These costs will be accumulated into their appropriate pool and divided by the allocation base to determine the forward pricing rate. Thus, one product of the planning process is the projection of the rates that will be proposed in bidding future contracts. For large contractors, the administrative contracting officer (ACO) and the contractor will attempt to negotiate an agreement concerning forward pricing rates to be used by the contractor on all proposals. For contractors without forward pricing rate agreements (FPRA), rates will be negotiated as part of each contract negotiation.

Negotiation of an FPRA may be requested by the contracting officer, the contractor, or the ACO. The contractor submits an FPRA proposal and certifies that the cost or pricing data are accurate, complete, and current as of the date of submission. The ACO will then invite the cognizant contract auditor, and contracting officers having significant interest, to participate in developing the government objectives and in the negotiations. Upon completion of negotiations, the ACO prepares a price negotiation memorandum and forwards copies of this and the forward pricing rate agreement to all affected parties. The forward pricing rate agreement provides specific terms and conditions covering expiration, application, and data requirements for systematic monitoring to assure validity of the rates. The agreement must provide for cancellation *at the option of either party* and shall require the contractor to submit to the ACO and to the cognizant contract auditor any significant change in cost or pricing data. The forward pricing rate agreement will be used in the negotiation of contractual actions expected to be performed during the period covered by the agreement, unless the ACO determines that the agreement is no longer valid.

In determining the amount of reimbursable indirect cost, the contractor utilizes a billing or provisional rate. The billing rates provide a method for interim reimbursement of indirect cost at estimated rates, which are subject to final adjustment. Billing rates impact on how rapidly a contractor is reimbursed for expenses incurred and, thus, impact on cash flow but not on contract pricing. The billing rates are used by the contractor in submitting invoices for cost incurred during contract performance. A contractor may, based on significant changes in its actual rates to date, ask the contracting office to modify its billing rates up or down to more accurately reflect actuals. The billing rate objective is to accurately predict the rate for the year using actuals-to-date and estimates for the remainder of the year. If a significant difference among the billing rate and the actuals to date develops, it is in the best interest of the government and the contractor to adjust the billing rate to its most likely year-end value. The billing rate should consider potential cost disallowances by the government and provide for a slight margin of error in anticipating year-end actuals. The bottom-line objective is to

develop billing rates that will recoup actual cost incurred during the year as accurately as possible.

The third method of overhead rate utilization is the final rate developed at the end of the company fiscal year reflecting actual costs incurred. These final rates as used in government contract costing refer to year-end actual rates as approved by the government on the basis of audit determination or negotiation. The final rates serve as the basis for costing contract close-out on cost reimbursable contracts. These contracts cannot be closed, and full payment of the fee made, until government approved final rates are established. In some instances, the negotiation of final rates has taken 5 years or longer, thereby creating a large backlog of contracts awaiting final closeout.

While a great deal of attention has been provided to the negotiation of allowable costs in the determination of final rates for defense contractors, the greatest impact on defense program cost is the negotiation of forward pricing rates. After-the-fact detemination of allowable cost is important to the final cost charged on cost reimbursement contracts; however, for fixed-price type contracts the allowability issue only provides feedback to the negotiation of the forward pricing rates. To achieve cost avoidance before contractor overhead costs are incurred, priority emphasis must be placed on forward pricing using fair and reasonableness criteria. The most effective cost control will be realized through sound forward pricing rate agreements.

One of the most difficult issues to assess is the reasonableness of the proposed level of indirect cost, and the associated allocation base, in the determination of forward pricing rates. This, however, is where the greatest benefit can be gained by the government in that it reflects directly on the negotiated cost of the contract, thereby determining the amount to be paid to the contractor for the work performed.

Indirect Cost Analysis and Management

Indirect costs typically represent one third or more of the cost on a contract. Clearly, it is a cost area that merits the attention of both contractor management and the Department of Defense. Analysis and control of indirect cost is a complex and difficult task. Comparing rates from different contractors can be misleading. Two similar contractors can have different rates for several reasons. Accounting systems may be different. For example, one contractor may classify production control as indirect labor while another contractor charges it as direct, or one contractor may use total cost as a basis for allocation for G&A while a second uses value added cost as the allocation base.

Contractor's rates may differ due to different products or production methods, rather than from accounting variations. For example, a first contractor produces a product using a manual method while a second contractor makes the same type of product in a highly automated facility. The automated contractor is likely to have a higher overhead rate because additional depreciation of the automated equipment, an indirect cost, is charged against a smaller direct labor base. The automated contractor is likely to experience higher overhead rates than is his less-automated counterpart even though his total product cost may be lower. Such differences make it important to remember that the government's objective is not to reduce overhead rates but to reduce total costs.

Although comparison of rates among contractors may not be fruitful, it may be useful to chart the trend of one contractor over time. Even this trend analysis would require adjustment for accounting, process, or business base changes. The most useful analysis would be one that looked at the indirect cost and cost trends in dollars, rather than at rates and rate trends. Are costs reasonable and well controlled? This type of cost analysis requires significant effort. It is the type of analysis done by the ACO and auditor in their rate review and negotiation functions.

Management of indirect costs is a contractor responsibility. Contractors who do significant military business must manage their indirect costs within the framework established by government policies. The role of the ACO and auditor are to assure that the contractor has an appropriate cost accounting system and operates in accordance with his system and the government requirements. The ACO and auditor review and negotiate the contractors' overhead rates.

Program managers and their staffs usually are not involved in the day-to-day administration of contractor overhead. When prices are based on cost,

however, the program manager must understand the contractor's cost. Although the program manager does not directly manage costs, he or she can encourage the contractor to be an aggressive cost manager. As the customer, the program manager has clout; as a government officer, the program manager should give the taxpayers their money's worth.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Business Management Department
Number: 2.7
Version: Update
Date: November 1988

I. TITLE

Should Cost

II. REFERENCES

—Federal Acquisition Regulation (FAR), Part 15.810

—DOD FAR Supplement

—DARCOM-R 715.92, "Procurement, Should Cost"

—DARCOM Pamphlet 715-7 "Procurement, Should Cost Analysis Guide"

—AF Pamplet 70-5, "Contracting and Acquisition, Should Cost"

III. POINTS OF CONTACT

—HQ, AMC (AMCPP-SC)
(202) 274-8304; AV 284-8304

—HQ, USAF, (AQCP)
(202) 697-5023; AV 227-5023

—NAVCOMPT
(Naval Center for Cost Analysis (NCA))
(202) 433-4006; AV 288-4006

IV. PURPOSE AND SCOPE

This Fact Sheet is designed to:

—Explain the purpose of Should Cost
—Identify circumstances when use would be beneficial
—Explain Objective of Should Cost Analysis
—Explain how to plan for a Should Cost Analysis
—Explain the process.
—Describe current trends.

V. DEPARTMENT OF DEFENSE POLICY

It is the policy of the Department of Defense to conduct Should Cost Reviews only for contracts where the dollar value and other contracting environmental factors are such that the payoff is likely to outweigh significantly the time, effort, and cost involved in conducting the review.

VI. SHOULD COST CONCEPT

Should Cost analysis is an approach to contract pricing which examines a contractor's cost proposal, supporting data, and rationale to determine a realistic estimate of what an item or service should cost. This approach involves the formation of an integrated team of government acquisition, contract administration, audit, and engineering representatives that conducts a coordinated, in-depth cost analysis at the contractor's plant. Among the areas examined are materials, manufacturing operations, engineering, accounting, cost estimating, make-or-buy, purchasing, organizational structure, overheads, and contract management. Besides striving to develop a realistic price objective, the team is tasked to uncover uneconomical or inefficient practices in the contractor's management or operations. Such findings are discussed with the contractor, so that any possible improvements can be made. The final product of a Should Cost becomes the basis for developing the government's negotiation positions.

It differs from regular cost analysis in its depth, in the fact that it is conducted at the contractor's plant and in the extent to which the government identifies and challenges the contractor's management and operations inefficiencies rather than merely challenging certain proposed costs.

VII. OBJECTIVE

The objective of a Should Cost review is to develop supportable negotiation positions. The most complete and detailed Should Cost analysis is of little benefit if its results can't be negotiated to improve the contractor's manufacturing and management operations in all areas of cost performance of present and future procurements. The review should identify non-essential government requirements, specifications, controls, and data that inflate contract cost/price.

Should Cost team members should be an integral part of the negotiation process, participate in the formulation of strategies, and support the procurement contracting officer (PCO), as required.

The PCO should be a participant in all Should Cost activities. Because of the extensive knowledge gained from the on-site comprehensive analysis of the contractor's operations and management system, the team chief or his deputy may be designated as the PCO's principal negotiator. To ensure a successful Should Cost analysis, the chief and his deputy shall be given as much authority as possible in selecting the team, establishing schedules, developing operation plans, and conducting the analysis.

VIII. SELECTING CANDIDATES FOR APPLICATION

A Should Cost analysis is expensive to conduct in terms of time, personnel, and other resources. The use of this approach should be reserved for situations where the potential gain from its conduct clearly warrants the expense. Specific guidance, especially as to when a Should Cost is mandatory and funding level considerations, varies among the services. The following are some conditions under which a Should Cost can be beneficial:

— Competitive forces are insufficient to ensure economical and efficient cost performance; i.e., sole-source situation.
— Future-year production requirements for substantial quantities of like items are projected.
— Specifications are comparatively definitive and not likely to be radically changed.
— The current and future dollar value of the work to be performed is substantial.
— Some actual cost data are available for the item in question or for similiar items.
— Known/suspected problems exist at the contractor's plant and may be causing increased costs; e.g., a history of increasing costs.
— The acquisition environment is one where the results of the Should Cost can be used effectively in negotiations. The government negotiator must have bargaining strength at least equal to the contractor. If the contractor is loaded with business, has a history of independence in bidding on other government contracts, the leverage available for applying the Should Cost results may be so small that very little value will be obtained for the effort expanded.

The Army requires a formal (formally structured and specifically chartered) Should Cost analysis on all sole-source procurements exceeding $10-50 million whenever the proposed acquisition doesn't meet the criteria for a formal (Level A) review, but an in-depth analysis by selected specialists is desirable to supplement a conventional proposal evaluation.

The Air Force requires that sole-source procurement over $50 million be considered for Should Cost review.

IX. SHOULD COST PROCESS

Preliminary Effort. The first phase of the Should Cost consists primarily of organizing. After the program and contractor for the review have been chosen, the team chiefs and team members will be selected. Careful choices are the key. The team chief should ordinarily come from the buying organization. This person should have proven leadership abilities, be an excellent manager, and possess a high degree of professional competence. The subteam chiefs are chosen for their knowledge in specific disciplines and their leadership abilities. One of them may be designated deputy team chief. Selection of the remaining team members may be done during this phase or delayed partially, or completely, pending an advance visit to the contractor's facility. After such a visit, a better estimate of team size and composition may be possible. The team cadre may request information from the contractor during this phase to clarify aspects of the proposal, or to gain data concerning his organization and operation.

Advance Team. During this phase the team cadre will review the proposal and other information pertinent to the Should Cost. They will plan and conduct an on-site visit to the contractor to determine the specific areas that require detailed analysis and the team members needed for the tasks. The team will ensure that the contractor understands the Should Cost methodology and the type of support that will be required during the review. Final selections for the remainder of the team will be made during the phase, if not previously accomplished. A Should Cost team must have personnel with a variety of skills. The proper balance depends on the specific circumstances of each review. Keeping this in mind the following list represents the areas of expertise usually included: industrial engineering, production engineering, design engineering quality assurance accounting, audit pricing, and management analysis. Team members are drawn from sources such as the program management office, Defense Contract Administrative Service (DCAS), Army Plant Representative Office (ARPRO), Air Force Plant Representative Office (AFPRO) Navy Plant Representative Office (NAVPRO) and Defense Contract Audit Agency (DCAA). *Before conducting the review, the entire* team will participate in a training session.

On Site Preparation. Once team members are familiar with their organization, mission and, possibly with the contractor's proposal, they will travel to the contractor's facility. On arrival the contractor should brief team members and give them an orientation tour of the facility. These presentations provide data on the organization, systems being produced, union agreements, cost estimating and cost-accounting procedures used for preparing the proposal and any other information desired by the team. The team will explain its operating procedures for the length of the visit to the contractor and provide him with the proposed activity schedule for the team. With these preliminaries completed the team will begin to gather data via observation, research and interviews. As results are analyzed, additional areas of interest may be uncovered.

Fact-finding and Analysis. With much of the information collected, the next phase involves the fact-finding and analysis of the proposal. This phase may begin before the previous one is actually completed and is normally conducted at the contractor's facility when questions and requests for additional information can be handled more rapidly. The main goal is to understand thoroughly every aspect of the proposal.

Prepare Report. The results of the Should Cost need to be documented so that final cost positions, long-term recommendations for improvements, and lessons learned become part of the program office records. Contractor acceptance or rejection of the findings, especially the recommendations should be included.

Prepare For and Conduct Negotiations. The negotiating team should thoroughly study the Should Cost findings. This data and the conclusions drawn from them provide the substance for the government position and enable the negotiator to intelligently present the government case. The real payback for the review will be gained during the negotiation. When the two sides settle the Should Cost process is complete.

Modifications. The Should Cost process described above is typical of a full-scale review. Since acquisition situations can be different Should Cost reviews should be tailored in terms of scope and activity to fit the particular circumstances.

X. SHOULD COST ADVANTAGES AND DISADVANTAGES

Advantages. Should Cost analysis improves the government's negotiating position by providing a clear and reasonable baseline. It identifies uneconomical or inefficient practices and unnecessary government requirements through the review process. Additionally Should Cost provides cost avoidances through long run savings on follow-on buys.

Disadvantages. Should Cost reviews are expensive and time consuming. The actual savings or cost avoidances from the reviews are difficult to quantify. Also, it's hard to staff the review team with qualified and motivated members.

XI. SUMMARY

The PM can benefit Should Cost. It can help your program by improving the government's negotiating position the contractor's production efficiency, and the contract's visibility, resulting in reduced contract costs. Should Cost may be tailored to your program needs. You should document and justify your reasons why it was tailored or was not used when required.

The DOD is required to present "up front" the total costs of creating and delivering as a "usable end item," each system for which it is seeking authorization.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Business Management Department
Number 2.9
Version: Original/Current
Date: December 1988

I. TITLE

Four Federal Monetary Concepts: Budget Authority, Obligation, Cost Incurred, and Outlay

II. REFERENCES

—Wilbur D. Jones, (ed.) *Glossary: Acquisition Management Acronyms and Terms*, Ft. Belvoir, Va: Defense Systems Management College, May, 1985

—Fred Waelchi, "Building the Acquisition Program Budget—A Conceptual Approach" *Armed Forces Comptroller*. Fall, 1984, pp. 10-20

—Office of the Assistant Secretary of Defense (Comptroller), *DOD 7110-1-M: Department of Defense Budget Guidance Manual*

III. POINTS OF CONTACT

First point of contact should be with the program manager's local servicing comptroller. Contacts should generally be held at the lowest possible level, because questions related to the monetary concepts of this fact sheet, when made in specific program contexts, tend to suggest potential program financial problems to the budget community, and may trigger a budget review. The "courts of last resort" for policy guidance are in the Office of the Assistant Secretary of Defense (Comptroller): Director for RDT&E (202-697-7563), and Director for Procurement (202-695-2234).

IV. PURPOSE AND SCOPE

The DOD uses several different monetary concepts in the evaluation of a program manager's financial performance. This fact sheet explains four different financial concepts—Budget Authority, Obligation, Costs Incurred, and Outlays—and how each is used in the measurement of a program's financial performance.

V. DOD POLICY

The DOD policy holds the program manager accountable for the use of the financial resources allocated to him; his employment of these resources is required to be efficient and fraud-free. One aspect of efficiency is the speed with which the PM puts his funds to work and the tenacity he exercises in keeping them at work. Efficiency is measured in several ways; this fact sheet discusses four, each resting on a different congressionally-defined monetary concept.

VI. FOUR MONETARY CONCEPTS

The traditional resource we think of in connection with a budget is money. In the federal budget system there are several kinds of "money" and several states that money can occupy. Three monetary concepts and one particular status of money are of primary importance in DOD systems acquisition management. The three monetary Concepts are Budget Authority, Cost Incurrence, and Outlay. The monetary status is called "obligation." These four concepts are discussed below in the order in which they occur in the budget execution process.

—*Budget authority* is authority to enter, in the name of the government, into transactions that ultimately cause funds to be paid out of the U.S. Treasury. Budget authority (also called obligation authority) is what the President requests each year from the Congress in his annual budget, and what the Congress creates in the appropriation process. Budget authority is not "money" in the colloquial sense; it is merely the authority to take the ac-

tions noted in the prior paragraph. When the PM uses budget authority in a contract, the actual cash implied in the transaction is still in the taxpayer's pocket. It is not until a few weeks before an actual outlay (check to be written) that the U.S. Treasury goes to the market to acquire the cash needed to cover the impending check. Budget authority is analogous to the authority implied by possession of a bank credit card (including a specified dollar "credit limit").

Acquisition budgets are stated in terms of budget authority, but are not originally computed in those terms. One of the other monetary concepts, "costs incurred," is the basis for the preliminary computation.

—*Obligation* is usually represented as the act of signing a contract or contract-like document. The obligating document is normally prepared, or at least initiated, in the program office. Obligation, in effect, represents the transfer of control over the use of budget authority from the program manager and his servicing comptroller to someone else, usually the organization that is actually going to perform the work. Obligation is analogous to the use of a bank credit card to make a mail-order or telephone purchase; the recipient of the order is authorized to act on the instructions of the card holder, and then submit his bill to the card holder's bank for automatic payment.

The concept of obligation is important because budget authority is created by the Congress with a limited lifetime for obligational purposes (the credit card expires). Depending on the appropriation, DOD budget authority must be obligated within 1,2,3, or 5 years—or the authority nominally expires. Thus obligation, because it protects budget authority from expiring, is the most significant action that must be taken with respect to budget authority, and is the program manager's most important mechanical financial responsibility.

Comptrollers monitor obligation rates very closely. Obligation rates that fall behind plan are interpreted as signals that are management difficulties in the program; perhaps inability of the PM and the contractor to agree on terms of a contract, or some other type of management problem that signifies program slippage. Low obligation rates can lead to reductions in the program current-year or future-year budget authority.

—*Cost Incurrence.* Due to congressional direction, this is the concept upon which acquisition budgets must be built. The Congress has directed that certain programs (those funded in the research, development, test, and evaluation appropriation—see fact sheet 2.8) will budget annually only for the amounts needed to pay for the work actually expected to be performed during each fiscal year—the annual "increment" of work. The "work to be performed" concept is a congressional attempt to match the timing of the availability of funds with the performance of the work. Since "work performed" has no intrinsic financial meaning, some recognized financial surrogate for this action was required; DOD chose "cost incurrence" to be that surrogate.

There is no precise definition of an incurred cost; the closest we come is the concept of a business accounting liability. An action by a prime contractor that creates an accounting liability, thereby incurs a cost under the DOD guidance. Actions analogous to the creation of an accounting liability, such as ordering of materials, signing of contracts, and application of labor, are treated as incurred costs at government facilities. Contractor or *government installation* cost incurrence is analogous to the mail-order house above ordering a third party to do work on behalf of the credit card holder; work for which the mail-order house is obligated to pay.

The concept of incurred cost is extremely important in the formulation of budgets—particularly in the Research, Development, Test, and Evaluation appropriation. It is less important in budget execution, probably because DOD has no good way to measure a contractor's (or a government installation's) rate of cost incurrence.

—*Outlay* (also "expenditure" or "disbursement" for purposes of this paper) is the actual paying of funds out of the U.S. Treasury. An outlay is usually thought of as the cashing of a government check; it is analogous to the bank cashing the check we mail in payment of the montly credit card invoice.

The outlay form of money is important because it is the monetary concept that measures the effects of federal spending on the economy, and in particular it is the monetary measure of the size of the federal deficit. As a consequence, it is also

the most politically sensitive of the monetary concepts and the one most used in congressional debate over the DOD budget. In this context, the usual congressional desire is to slow down or put off the outlay of funds.

It is normal practice for comptrollers to monitor program outlays rates, and use these rates as measures of actual program progress. An outlay rate that falls behind plan is taken as a signal that program execution has slipped. In this context, therefore, the pressure is to speed up outlays. It is not unknown for a program to become so bound up in conflicting pressures regarding outlays that normal program considerations of performance, schedule, and cost become (at least temporarily) secondary concerns.

—A recap of the sequence of monetary events. First comes creation of budget authority through a Public Law (typically an appropriation bill), and the passing of this authority to the PM and his servicing comptroller. Next is the obligation of budget authority through a contract or contract-like document, then the incurrence of cost by the recipient of the contract, and finally the presentation of a claim for payment followed by an outlay.

Because the core of the annual political and economic debate over defense spending is outlays (even though the budget requests—and the appropriation laws grant—budget authority) it is important to understand that the controlling steps in the outlay process are first, the creation of budget authority, and second, the obligation.

Fund obligation is a responsibility of the PM and requires positive action by him. After obligation, the succeeding steps—cost incurrence and outlay—occur as consequences of the authority passed on in the obligation process. No further formal permission or authorizations are required for the contractor to incur costs or to present a bill for payment. When a legitimate bill is submitted for payment it becomes an entitlement and is paid without recourse to any further approval process. Thus, once the financial machinery is set in motion by an obligation, the process rolls on to the outlay of funds without governmental or DOD control. The only controls regarding outlays are indirect ones; the creation of budget authority, and the timing of the obligation process.

Because of the economic and political significance of the federal deficit, and the crucial role that outlays play in the deficit, proposals for some form of direct outlay control—such as we see in some allied countries—are being debated in the executive and legislative branches. It seems likely that such controls, should they occur, would make the weapon systems acquisition process more difficult.

VII. SUMMARY

Each of the four monetary concepts described in this fact sheet plays a part in the daily operational life of the acquisition program office. Each must be understood by the program manager and by his financial staff in order to deal competently with the command, military department, and DOD financial communities, and with the Congress.

FACT SHEET PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS MANAGEMENT COLLEGE

Author: DSMC, Business Management Department

Number: 2.10
Version: Original
Date: December 1988

I. TITLE

Could Cost Analysis

II. REFERENCES

Could Cost Analysis is a recent initiative from Under Secretary of Defense (Acquisition). No specific directives or instructions on this subject are available at this time. However, there are references available on the following topics related to Could Cost, as described in later sections of this fact sheet:

—Should Cost. FAR 15.810 Should Cost; A.F. Supplements to FAR; AFR 70-5 (being updated). Also, see Fact Sheet 2.7

—Industrial Modernization Initiatives Program (IMIP), see Fact Sheet 7.3

—Acquisition Streamlining. DODD 5000.43, "Acquisition Streamlining"

—Baselining. DODD 5000.45, "Baselining of Selected Major Systems"

—Multiyear Procurement, see Fact Sheet 3.2

—Value Engineering Changes. OMB Circular 131A; DODD 4245.8; DODI 4245.8H. Also, see Fact Sheet 4.13

III. POINTS OF CONTACT

OSD:
Office of Assistant Secretary of Defense Procurement and Logistics (OASD(P&L))
Washington, D.C. 20301-8000
(202) 697-6710

Army:
HQ, Army Materiel Command
AMCPD-5
5001 Eisenhower Avenue
Alexandria, VA 22333
(703)274-8333

Navy:
Office of Assistant Secretary of the Navy (Shipbuilding and Logistics)
Contract and Business Management
OASN(S&L) Code CBM
Crystal Plaza, Building 5, Room 506
Washington, D.C. 20360
(202) 692-8668

Air Force:
HQ, Air Force Systems Command
Business Management Division
(HQ AFSC(PKMA))
Andrews Air Force Base
Washington, D.C. 20334
(301) 981-4008; AV 858-4008

IV. PURPOSE AND SCOPE

In his Senate Confirmation Hearings in November 1987, Dr. Robert Costello, Under Secretary of Defense for Acquisition, advocated a change in the way DOD does business, which would provide substantial reductions in the cost of developing and producing defense systems and military products. He calls this methodology "Could Cost." To demonstrate this methodology, he tasked each of the military service departments to initiate a demonstration project in their area. The Army chose the Bradley Fighting Vehicle; the Navy, the Trident D-5 Missile Program; and the Air Force, the B-2 Advanced Technology Bomber. The Defense

Systems Management College (DSMC) became involved in this effort when asked to assist McDonnell Douglas Helicopter Company and the Army Aviation Systems Command (AVSCOM) in performing a Could Cost analysis of the eighth production buy of the Apache Helicopter. While this analysis has not been completed, DSMC has received many requests for further information about how to perform a Could Cost Analysis. The purpose of this fact sheet is to provide guidance in considering the following topics:

—What is Could Cost?

—How to do a Could Cost analysis

—Technical aspects

—Framework for analysis

—Need for cost baseline

—Behavioral aspects

—Need for dialogue between government and contractor

—Need for incentives to contractor.

What Is Could Cost?

The first step faced in assisting the Apache effort was to formulate an approach to doing a Could Cost analysis. This involved finding out how Dr. Costello defined "Could Cost"; formulating a "first cut" proposed approach to meet the objective; and networking among organizations to test, validate and improve this approach.

After reading Dr. Costello's testimony to the Senate Armed Services committee as part of his confirmation hearings, a tentative approach to such an analysis, could be formulated. Contact was made with members of Dr. Costello's office, specifically the designated OSD point of contact. Also, contact was made with the OSD Cost Analysis Office, and a visit arranged with Rear Admiral Ken Malley, Program Manager of the Strategic Systems Program, to discuss his approach to performing a Could Cost analysis of the D-5 Trident missile system.

There are several essential points making Could Cost different from other related approaches to cost reduction.

Could Cost is a cooperative effort between the government and a contractor, aimed at improving business methods. It is a way to determine what a system would cost if contracts were written to minimize the non-value-added work done by a contractor. It is a way to achieve advantages of competition when a sole-source procurement environment exists (although the approach can be used in a competitive environment). It is more than the "Should Cost" approach DOD used in the past in sole-source negotiations with the contractor.

Basically, a Could Cost analysis consists of reexamining the total acquisition process to improve this process and arrive at a lower-cost, quality product. The Apache team defines Could Cost as a cooperative government and industry process of eliminating all non-essential effort (labor, material and other costs) while ensuring product performance and quality at the same time.

In performing a Could Cost analysis, the team should focus on three primary ways of reducing cost as follows:

—Reexamine system specifications to eliminate "gold plating" or unessential specifications contributing little to the accomplishment of the military task.

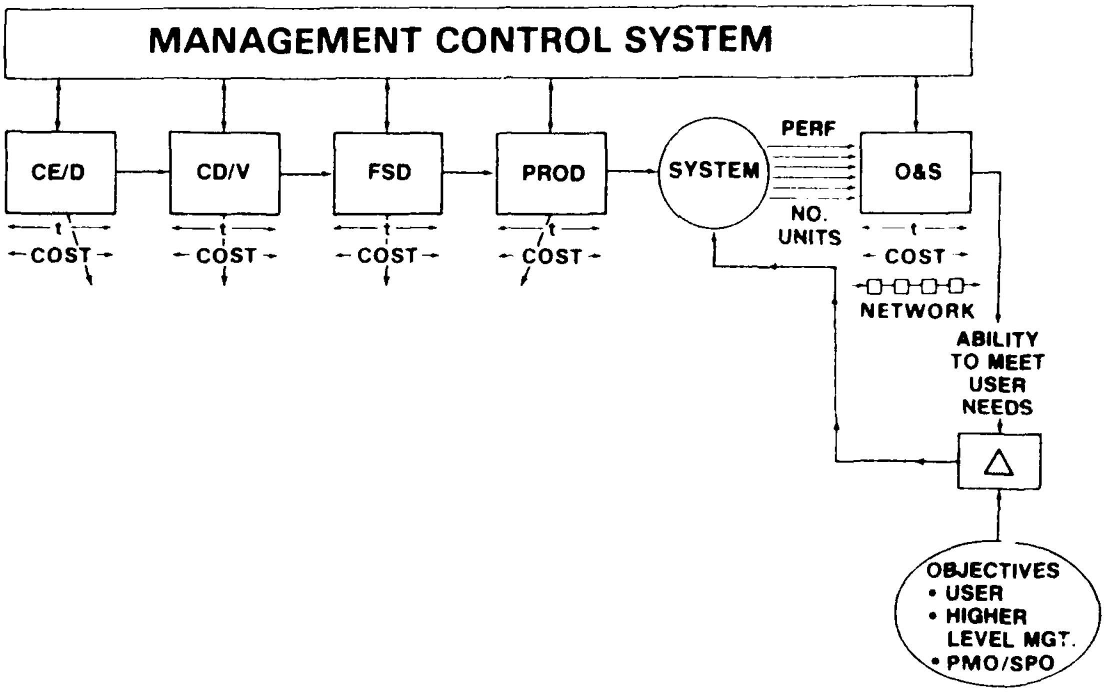
—Determine the most efficient, feasible way of performing the development or production work process, as opposed to continuing the previous work process. This is essentially the proper way of doing a Should Cost analysis, as shown in several DOD demonstration projects like those reported at the 1987 DOD Cost Analysis Symposium.

—"Streamline," that is, tailor or interpret various directives and regulations associated with the way the government acquires systems.

Using the Could Cost Analysis Process

To examine these three analytical methods, refer to a structure used at the Defense Systems Management College modeling the current acquisition process; one found to be helpful in generating system improvements. As shown in Figure 1, a system is acquired through a management control process, which divides the entire system acquisition process into phases (concept exploration/definition, concept demonstration/validation, full-scale development, production deployment, operations and support). As each phase is completed, higher-level DOD management can review to validate the phase has been satisfactorily completed and, hence, the program can proceed.

Figure 1. MANAGEMENT CONTROL SYSTEM WORK PROCESS IN SYSTEMS ACQUISITION



Key principles in Figure 1 follow:

—Starting with the concept exploration/definition phase, a user objective, as stated in the Defense Guidance, mission area and mission need statement, is satisfied. The objective is to provide a system to perform a given military task(s) by a given schedule (e.g., IOC).

—Objective of higher-level management is to ascertain that validated user objectives are satisfied and the system is affordable.

—Objective of the contractor is to perform necessary system design trade offs so that the set of performance characteristics obtainable in the field and the number of system units required will meet the validated user objective at lowest total cost (generally present value life-cycle cost), taking into account risks and uncertainties.

—Objective of each succeeding phase is to continue the development and testing process to validate the specifications the system will ultimately provide in the field. If there are major changes in later estimates of achievable performance characteristics, it is the responsibility of the contractor to perform new trade-off analyses to arrive at the lowest cost to meet the validated user objective. Thus, the contractor is periodically modifying estimates of performance, schedule and cost for each succeeding phase in the acquisition process.

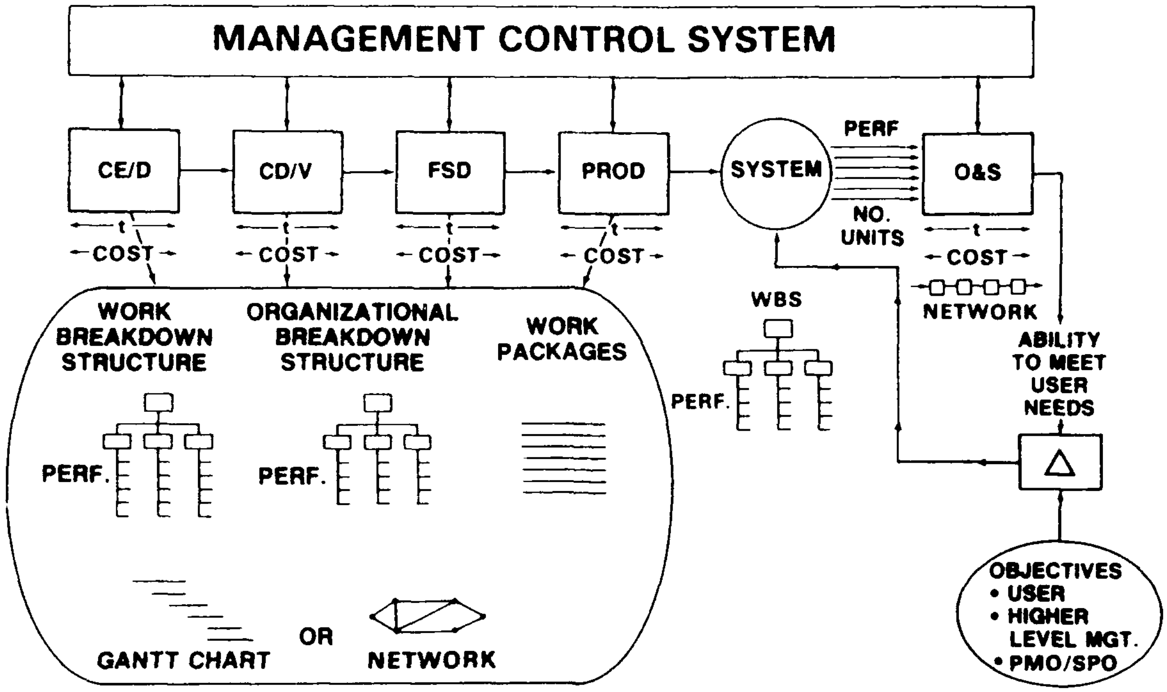
Supporting Analytical Tools

—One management requirement provided at the end of each phase is an estimate (or reestimate) of the time and cost of each succeeding phase in the acquisition process for purposes of program planning, budgeting and control. To aid in making such estimates, the contractor can use analytical tools, as shown in Figure 2.

—A work breakdown structure (WBS) listing in hierarchical form various hardware and software deliverables to be furnished during this phase, and performance or quality standards associated with each deliverable.

—An organizational breakdown structure (OBS) listing in hierarchical form the contractor's organization to be applied to each phase.

Figure 2. MANAGEMENT CONTROL SYSTEM WORK PROCESS IN SYSTEMS ACQUISITION



—A set of work packages (sometimes called tasks or activities) needed to be accomplished to generate the contract deliverables.

—A cost-estimating technique; the cost of each phase may be estimated in one of several ways, depending on available data. A "bottoms-up" cost estimate may be made by considering what elements must be purchased (e.g., subcontracts, new tooling, development, test and production equipment required). These can be identified from the organizational breakdown structure, and the set of work packages. Other bottoms-up costs may be obtained from work packages associated with the development or production process. These costs include cost of labor, material and other direct costs for each work package, and overhead costs. Operations and support costs can be estimated from a network representing the operations and support process to be followed. In certain early phases, analogy or parametric cost estimating techniques might be used to estimate costs.

—A program scheduling technique; delivery schedule of each phase may be estimated using a Gantt Chart or network which arranges work packages in time sequence (or by interdependencies). Having a network permits the use of critical path scheduling techniques. Alternatively, parametric equations may be used to estimate schedule if sufficient data relating performance characteristics to schedule are available.

Using the Structure

The structure of Figure 2 can be used to focus on each of the three opportunities for reducing system cost, as previously described. The first step is to generate a system baseline since all analyses will be performed on a relative basis; i.e., comparing a proposed alternative course of action vs. the current system baseline to see if lower costs result. In the case of Apache, the specific baseline was defined as a proposal being currently generated consisting of the eighth production buy of Apache helicopters for FY 1989. Performance characteristics, including all government regulations and directives to be followed, were specified by AVSCOM. The production process and a cost estimate for this production lot is being generated by McDonnell Douglas.

Revalidation of Performance Specifications

—Consider the first thrust of a Could Cost analysis: revalidation of performance specifications. In the Apache production proposal, there is to be no change in performance specifications for the production lot. Certain improvements (changes in specifications) will be proposed in 1989 as an Apache modernization program. Using a Could Cost analysis, each of these changes in specifications could be analyzed in the following way: list improvements being proposed; indicate benefits over time associated with each change; indicate costs over time associated with each change; relate benefits to cost. Let's consider examples of how benefits and costs can be quantified and evaluated against one another, using techniques described.

—Parts Corrosion

—Apache is considering a redesign of certain parts whose useful lives are being reduced through corrosion. Two types of benefits are available. First, existing corroded parts require replacement, or overhaul more frequently than an improved part that does not corrode. Thus, comparing the improved part vs. the baseline part indicates cost savings in labor and parts due to a reduced frequency of replacement during an assumed life cycle. In addition, each time there is a repair or replacement action there is downtime in which the system is not available, thereby reducing operational availability or readiness rate of the system. Thus, the second benefit of an improved system is the increased availability rate that could be translated into less aircraft required to be procured to meet a given specified availability rate than the baseline system. Thus, downtime can be translated into additional effective savings of having to procure less aircraft to meet a given mission requirement.

—Improved Fault Detection/Location Equipment

—This improvement consists of sensors which detect a failed or failing part and give location of this part. Here we compare savings in maintenance time for an improved maintenance system vs. the baseline in terms of the manpower time saved in detecting and locating a fault. The false-alarm rate of replacing a wrong part also must be considered. As in the previous example, this savings in time can be converted to savings in labor cost as the primary cost savings. In addition, the improvement in availability rate also should be converted into effective savings in procuring less equipment, as previously described.

—To evaluate the cost effectiveness of each proposed change, the cost associated with each improvement must be considered and compared against benefits on a total life cycle cost basis. Cost vs. time can be estimated by using tools shown in Figure 2 as addressed in subsequent paragraphs.

What is the current status of the proposed improvement? Has it been completely developed and hence, only needs to be produced and installed? Or, is additional development required? What cost savings will the proposed improvement provide during its assumed operational life? From these analyses a cost-benefit stream can be developed. From the development/production network an initial cost stream (development, production and installation) of investment costs to be incurred before operations can be developed. This is followed by a benefit stream of total estimated savings during an expected life of the improvement. From this, we can develop two cost-benefit measures. The first consists of the present value net savings of the entire cost-benefit stream, using a discount rate (say, 10 percent) provided by the Office of the Secretary of Defense. This measures total net benefits of each proposed improvement.

A second measure is the savings to investment ratio (SIR), defined as the ratio of discounted net benefits to discounted investment costs. This is a good way to rank proposed improvements where there is a limit on investment costs available.

While the impact of possible changes on cost has been considered, note that many times changes are proposed too late to have beneficial effects. For example, the Trident Program was asked how much savings would occur if missile accuracy were reduced. The answer is: There would be no savings! The development has been completed and the missile is in production. Savings in recurring production cost would be counterbalanced by the cost of additional development, testing and, perhaps, non-recurring production costs.

Extending this principle, when can maximum cost savings be achieved by "scrubbing requirements"? There is an old saying that 75-85 percent of all costs are locked in when the concept exploration

phase is completed. It is important to place closest attention to scrubbing requirements early in the acquisition process. This involves focusing on the military task to be done by reviewing the Defense Guidance, mission area analysis, mission need statement, Service statement of operational requirements and the requirements being prepared within the systems engineering process. Then, trade offs are made to find the system requiring the lowest life-cycle cost to meet military task and operational and affordability constraints.

Should Cost Analysis

—The second thrust of a Could Cost analysis involves a Should Cost analysis. There are differing opinions regarding how this should be done. Some think Should Cost involves merely assuming the same work process will be continued into the next phase, and that the only improvement is the assumed learning or improvement curve extended out for later production quantities. This is an incorrect definition of Should Cost since it assumes the same work process will be followed. A true Should Cost analysis involves a team of trained industrial engineers and others critically reviewing the proposed work process (shown as the network or Gantt Chart of Figure 2) and identifying improvements that could be made to the work process so that perceived ineffeciencies will not be continued. Immediate reduction in recurring costs can be made in addition to future learning/improvement curve improvements for subsequent quantities.

Improvements From Streamlining

—The third thrust of a Could Cost analysis involves a reexamination, tailoring and interpretation of acquisition directives and regulations which the government places on the contractor during the acquisition process. This is represented by the box labeled Management Control System in Figure 2. Examples of potential cost savings include the use of multiyear contracts permitting optimal production rates and economic ordering quantities. In the Apache program, McDonnell Douglas indicated it was subject to 1,500 audits requiring an average of 25 contractor personnel to service each audit. Quality assurance inspections, being conducted first by the contractor, were repeated by the government. For their commercial work, McDonnell Douglas stated this is done once. Realizing that each inspection performed reduces risk to the government, McDonnell Douglas then indicated a willingness to remove this risk by providing a contractual warranty for their quality; this would warrant performance and failure rates by paying for lack of performance and deficiency in operational availability rate. Such warranties would motivate the contractor to build quality into the work process to avoid extra costs.

The company claims certain reports they now generate as a contract data requirements list (CRDL) no longer are used, yet they still must provide them under the contract. Sometimes, data in the contract performance reports (CPR) have unnecessary detail; i.e., except for high risk elements, is it required to report below the third element of the WBS?

The contractor was able to propose ways to reduce the cost by better tailoring of government acquisition regulations, giving the contractor relief of low-value acquisition regulations. It was recommended the government can evaluate each alternative option in the following ways:

—The contractor estimates the cost of doing business using existing regulations and directives. (This is their baseline proposal responsive to the current request for proposal (RFP) for the 1989 buy).

—The contractor lists the changes or modifications in directives, etc., which would reduce contractor and, perhaps, government costs of doing business, and an estimate of cost savings that may be obtained.

—The contractor reviews proposed changes and costs savings with AVSCOM which decides which ones are worth pursuing in more detail.

—The contractor makes a final, more accurate, proposal of cost reduction associated with each acceptable option.

In the Apache analysis, McDonnell Douglas was able to generate some 147 high potential cost-reduction candidates, of which 58 were accepted by AVSCOM for further detailed analysis.

Behavioral Considerations

Consider behavioral aspects in obtaining improvements to the way business is done, including forces aiding or preventing these happenings.

The process described involves an effort from government and contractors. Full benefits can be obtained only if both sides are proactive in the process.

Modifying requirements appears to be a fairly continual process during the acquisition cycle as new ways of improving the system in a cost-effective fashion are generated. It is in the contractor's financial interest to generate such improvements and he will continue to do so. Remember that the most important time to scrub requirements is in the concept exploration phase before key system characteristics, and costs, are locked in.

The contractor can readily generate sensible recommendations for streamlining, particularly if involved in a commercial business like McDonnell Douglas Helicopter Company. It has a baseline of doing business commercially, which can be used to compare against AVSCOM directives. The company can estimate cost savings that could be achieved by tailoring such acquisition specifications, and feel they lose nothing in making such changes, which produce a new affordable product. The key is for the government to construct the contract to *motivate the contractor to produce a quality product as lower cost*; i.e., by requiring payment for defects and loss of availability levels below what is normally expected using the current system baseline.

Consider the behavioral pressures that motivate a contractor to make changes to reduce the cost of the work process (Should Cost aspects). In a competitive environment the contractor is concerned with the proposed price, since this affects winning the contract and market share; the strong pressure is to improve proposed cost. In a sole-source environment (say, follow-on production contract), the current acquisition process may force the contractor into the following business strategy which is counter-productive to Could Cost:

—Don't look for cost-reduction improvements to work process before contract is signed.

—Propose highest cost work process that is justifiable; i.e., continuation of previous work process used and the highest learning/improvement curve slope that is justifiable.

—After a firm fixed price or incentive type contract is signed, make appropriate efforts to reduce cost.

Here are reasons pushing the contractor toward such a strategy. Given that the contract type is probably firm, fixed price or incentive type, the contractor would like the final price or target cost to be as high as can be justified, since final profit is based on negotiated cost and improvements made during implementation. The contractor knows the government will insist on negotiating a learning/improvement curve which will require subsequent improvements to make target cost. Why propose many cost reduction improvements initially? Also, why should the contractor begin analytical efforts to improve work process before starting the contract? Under the Truth in Negotiations Act, disclosure of improvements might be made later and this will be used against the contractor in negotiations. It would be advantageous to delay the improvement analysis until start of the contract. For these reasons, in a sole-source environment it is felt to be essential that a Should Cost analysis of the contractor's work process take place. The government should take a proactive lead in the Should Cost effort by reviewing the contractor's proposed work process and making recommendations for improvement based on government knowledge and experience in this area (including what other contractors are doing). In this way the government can drive the target cost down in a reasonable, acceptable fashion, and the contractor will share in additional cost reductions that can be generated. However, this effort requires that the government have access to experts with experience in the areas being reviewed.

In the absence of a government Should Cost team, it is believed the acquisition system should find some way of rewarding the contractor for reducing the work process cost as compared with a baseline of the previous (current) work process as audited by DCAA. In this way, the contractor could be motivated to generate cost improvements in time for making an initial proposal to the government. This would reduce the target cost of an incentive type contract and provide additional time for implementing the improvements, presumably reducing cost of a larger number of units.

There are times when a contractor-proposed cost improvement may not provide benefits originally planned. If creative thinking is to be encouraged, it is unfair for the contractor to assume all risks for such proposals. Perhaps such uncertainties in

estimated reduced costs need to be included by adjusting the target cost and the incentive share line to reflect such uncertainies.

V. CONCLUSIONS

A Could Cost analysis can be an opportunity for government and contractor, as a team, to reexamine all facets of their current method of acquiring defense systems and products with the end-objective of generating lower-cost ways to obtain a quality system or product to meet the military need.

This fact sheet described three major ways of reducing such costs:

—Properly scrubbing requirements

—Performing a Should Cost analysis of the contractor's work process

—Properly interpreting or tailoring government directives and regulations required to acquire the desired system or product (streamlining).

There is nothing essentially new in the methodology of each of these approaches. What is new is a challenge to consider all of these approaches in looking for better ways of doing jobs.

Certain obstacles are identified which prevent meeting the full potential for cost improvement:

—The contractor needs incentives which will reward efforts at cost reduction, or conversely will not reduce revenues or profit.

—The government needs similar incentives for their efforts.

INSERT TAB 3

PROCUREMENT PLANNING

AND

CONTRACT MANAGEMENT

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Business Management Department
Number: 3.1
Version: Update
Date: November 1988

I. TITLE

Competition Planning

II. REFERENCES

— Federal Acquisition Regulation, Part 7, Acquisition Planning

—DOD FAR Supplement, Part 207, Acquisition Planning

—Defense Systems Management College Handbook, *Establishing Competitive Production Sources*, August 1984 (DTIC #ADA 146 006)

—Defense Systems Management College Handbook, *"A Program Office Guide to Technology Transfer,"* November 1988

III. POINTS OF CONTACT

—Your command competition advocate
—Your contracting officer

IV. PURPOSE AND SCOPE

The purpose of this Fact Sheet is to present a general introduction to these areas. Details regarding specific implementation actions associated with particular technology transfer approaches are presented in the DSMC Handbooks, cited above as reference.

V. DOD POLICY

DOD Policy, specifically the FAR and DOD FAR Supplement, require the program manager to accomplish integrated, comprehensive acquisition planning. Included in this guidance are some aspects of planning for competition. DOD policy does not require a specific and distinct Production Competition Plan; however, because of the variety of issues which must be effectively managed in a successful production competition, such a plan is highly recommended.

VI. RECOMMENDED PRODUCTION COMPETITION PLAN CONTENT

Often, the planning associated with production competition is documented in a number of plans, strategy papers and budget books. This dispersion of documentation greatly complicates the implementation and execution of a competitive production program. Therefore, the program manager should develop a single, integrated production competition plan that addresses all critical issues, which includes the following:

—Technology transfer

—Selection of the second source

—Contractual arrangements

—Second-source qualification

—Schedule

—Configuration management

—Funding.

Technology Transfer

The production competion plan must address two critical areas related to the technology transfer:

—The availability of adequate technical data

—The level of support required from the systems developer.

The availability of adequate technical data to the program office and the second source is an integral

component of a successful production competition program. The level of data required depends upon the method of technology transfer. For example, a TDP approach requires a detailed data package that includes all documentation, but more continuing engineering support. The production competition plan should delineate all required design and production data, as well as test requirements, special test equipment drawings, quality assurance requirements, and approved engineering change orders.

To enhance technology transfer and to reduce the risk of inadequate documentation, the program manager may request the system developer to warrant the technical data package. If such an approach is envisioned, the program manager should reflect this in the production competition plan and obtain contractor agreement to the warranty provision prior to full-scale developement (FSD).

The system developer may resist providing complete documentation on the grounds of proprietary data. The program manager can obtain rights to proprietary data by requesting the competing developers to identify and price all proprietary data embodied in their designs as part of their FSD proposals. The availability of data and the cost of data could be employed as explicit source selection criteria. This approach enables the program manager to proprietary data early in the program, in a competitive environment. The specific actions related to this approach should be discussed in the production competition plan.

The required level of support from the system developer also should be described in the production competition plan. The developer's support could involve several activities, depending upon equipment complexity, program schedule, and the desired level of commonality between the two producers' equipment. These activities include the following.

Technical data package preparation:

—Provision of key subsystems, or the entire system, to the second source

—Direct technical assistance and consultation

—In-plant assistance

—Licensing of proprietary data

—Development of subtier suppliers

Prior to FSD, the program manager must make an independent assessment of the desired level of devloper support, considering the technology transfer method. The desired level of support then should be included in the FSD solicitation as an option and defined in the production competition plan.

Ensuring adequate support from the system developer may require special incentives. For example, award fees have been employed successfully on prior production competition programs. In addition, innovative incentives have been developed that base the developer's progress payments on the progress of the second source. The incentives adopted by the program should be clearly delineated in the production competition plan.

Selection of the Second Source

The production competition plan must describe the process for selecting the second source. The second source can be selected either by the government or by the system developer. In the first case, the government would solicit and select the second source, leading to the award of a prime contract to the second producer. Another method is to allow the system developer to solicit and select the second source subject to program office approval.. In this latter case, the system developer would prepare and execute a source selection plan covering planning, RFP preparation, solicitation, proposal evaluation, and award. The second source would be a subcontractor to the developer during the technology transfer period.

Both methods have been employed successfully on prior competitive production programs. Whichever method is selected, the program manager must ensure that the production competition plan reflects the following:

Second source qualification criteria, including engineering, manufacturing, cost, and capacity requirements

A source selection plan that is in accordance with the program schedule

Degree of program office control over source selection and final approval of the selected second source

Contractual Arrangements

Two of the technology transfer techniques involve separate contracts with the two producers. The TDP

and form, fit and function (F^3) approaches are contractually implemented in this manner. For these techniques the production competition plan should describe the type of contracts, the incentives to be used, and anticipated contract funding levels.

For other technology transfer techniques, the production competition plan must address the contractual arrangements in more detail. For example, when using a leader-follower or a licensing technology transfer technique, the government can establish the second source using either of the following contractual approaches:

A clause could be included in the developer's FSD contract specifying that a certain portion of the developer's initial production be subcontracted to a second source. The developer would be responsible for technology transfer, production qualification, and acceptance tests of the second source's initial production units.

The second source could be a prime contractor to the government and technology transfer could be accomplished through a separate engineering services contract with the system developer.

Similarly, contractor teaming can be implemented using either a subcontract or joint-venture approach.

The alternative contractual approaches have associated advantages and disadvantages. For example, establishing the second source as a subcontractor reduces the administrative burden on the program office; however, it also reduces program office control over the technology transfer process. Each approach also affects other implementation planning areas in different ways, depending upon the specific technology transfer technique. For example, establishing the follower as a subcontractor to a leader company may result in the leader company performing follower qualification. On th other hand, the use of a subcontract arrangement for contractor teaming does not affect the requirement for government qualification of both producers.

Given a stated technology transfer technique, the production competition plan should present the advantages and disadvantages of alternative contractual approaches in relation to program characteristics. In assessing the relative advantages and disadvantages of the two approaches, the program manager should consider the following:

—Program office personnel requirements

—Program office access to the second source

—Program office control over the technology transfer process

—Contractor cooperation and motivation in developing a second source

Second-Source Qualification

Production qualification of the second source can be achieved either by the government or the system developer, depending upon the technology transfer method and the contractual relationship between the producers. Both of these methods have been employed successfully on prior programs. In developing a production competition plan, the program manager should ensure that the plan addresses the following:

—Qualification responsibilities

—Quality assurance

—Tooling

—Test equipment

—Suppliers

Schedule

The production competition plan should present an integrated milestone schedule for second source selection and qualification. This schedule should reflect ongoing program activities in other areas, as well as critical production competition milestones. The schedule should work back from the desired second source qualification date and initial competitive award date. Potential milestones include the following:

—Initial management meetings

—Design briefings and engineering exchange

—Data item delivery

—Subassembly delivery and inspection

—End-item disassembly, inspection, and reassembly by the second source

—End-item fabrication

—Production qualification

—Release of RFP for initial competitive production

—Competitive proposal submission

—Source selection and award

—Long lead release

The exact activities related to each of these milestones would be defined by program characteristics. The key is to identify relevant milestones and tie those milestones to the developer's contract. The program manager then has a useful tool to monitor progress and to motivate the dveloper. Furthermore, an integrated schedule will provide the program manager with insights relevant to production planning, long release dates and competitive solication.

Configuration Management

In developing a production competition plan the program manager must address configuration management issues. The system developer typically maintains configuration control up to Critical Design Review (CDR); however, the program office may assume configuration control earlier to avoid design changes that adversely affect competition. The competition plan should present a configuration control milestone. In addition, the plan should define the structure of the Configuration Control Board. To enhance competition, both contractors should be represented on the board. Similarly, the processing and control procedures applicable to Class I and Class II Engineering Change Proposals (ECPs) should be discussed.

Funding

The production competition plan must identify all required funding necessary to implement the production competition program. The funding requirements should be delineated by appropriation category. For example, research and development funds may be required for technical data rights, second source development efforts, qualification testing, and engineering services associated with technology transfer.

Similary, production funds may be required for additional tooling, as well as for production end items. The production or procurement accounts should clearly present annual procurement quantities and projected funding requirements by line item. This will enhance the program manager's ability to

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PRODUCTION COMPETITION PLAN

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1. OVERVIEW
- 1.1 System Description
- 1.2 Technology Transfer Approach
- 1.3 Structure of the Plan

2. MANAGEMENT ORGANIZATION
- 2.1 System Developer
- 2.2 Second Source
- 2.3 Program Office

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- 3.2 Proprietary Rights
- 3.3 Required Technical and Management Support
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- 4.1 Responsibilities
- 4.2 Selection Criteria

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- 5.1 Contractual Arrangements Between Producers
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6. PRODUCTION QUALIFICATION
- 6.1. Philosophy
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7. MASTER SCHEDULE
- 7.1 Source Selection
- 7.2 Lead Times
- 7.3 Qualification
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8. CONFIGURATION MANAGEMENT
- 8.1 Responsibilities
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assess the effect of the potential budget reductions on the competitive production program.

VII. CONTENTS OF A PRODUCTION COMPETITION PLAN

Deliberate and thorough planning is essential to the success of a production competition program. The specific contents of a plan are determined by program circumstances; however, there are several general areas that should be included in all production competition plans. The following represents a sample outline of a production competition plan to assist the program manager in developing a plan for a particular program.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Business Management Department
Number: 3.1.1
Version: Update
Date: December 1988

I. TITLE

Competition Requirements

II. REFERENCES

—Federal Acquisition Regulation (FAR), Part 6

—DOD Federal Acquisition Regulation Supplement (DFARS), Part 206

—Army, Navy or Air Force FAR Supplements, Part 6

—DOD Directive 4245.9, Competitive Acquisition

III. POINTS OF CONTACT:

—Your Competition Advocate
—Your Contracting Officer

IV. PURPOSE AND SCOPE

This fact sheet provides a summary of the competition requirements contained in FAR, Part 6, that the program manager should be aware of when planning acquisition strategy.

V. IMPLEMENTATION

Policy guidance is contained in references above. In addition, you should be aware that each service has service-unique implementing regulations that may contain provisions appropriate to your program.

VI. CONTRACTING METHODS

(1)FULL AND OPEN COMPETITION (REF: FAR/DFARS 6.1/206.1)

COMPETITIVE PROCEDURES

—*Sealed Bids*; previously called formal advertising, shall be used if:
—Time permits
—Award solely on basis of price related factors
—Discussions unnecessary
—Reasonable expectation of receiving more than one sealed bid.

—*Competitive Proposals*, previously called Competitive Negotiation, used if:
—Sealed bids not appropriate.

—*Combination of Competitive Procedures* may be used if:
—Sealed bids not appropriate
—Includes two-step sealed bidding, previously called two-step formal advertising.

—*Other Competitive Procedures*

—Selection of sources for architect-engineer contracts
—Basic research proposals
—Multiple award schedules.

(2) FULL AND OPEN COMPETITION AFTER EXCLUSION OF SOURCES (REF: FAR/DFARS 6.2/206.2)

—*Policy* (FAR/DFARS 6.201/206.201)

—*Establishing and Maintaining Alternate Sources* (FAR/DFARS 6.202/206.202)

—Sources may be excluded from competing in order to establish or maintain alternate sources for increasing competition, industrial mobilization, or maintaining an essential nonprofit engineering, research, or development capability

—Agency head (or designee) determination and findings (D&F) required for each contract action under this part

—Sources may be excluded to meet statutory requirements for small business or labor surplus are set-aside.

(3) OTHER THAN FULL AND OPEN COMPETITION (FAR/DFARS 6.301/206.301)

—Policy

—Permitted only by statutory authorities cited under 6.302/206.302

—Cannot be justified, due to the lack of advance planning or the imminent expiration of funds

—Offers solicited from as many potential sources as practicable

—Contracting methods in FAR Parts 14 and 15 may be used.

—Authorized Exceptions (FAR/DFARS 6.302/206.302)

—Only one responsible source and no other type of supplies/services will satisfy agency requirements

—Only unique supplies/services can satisfy agency needs

—Follow-on contracts for continued development or production of a major system or highly specialized equipment (for further discussion see FAR 6.302-1(2))

—Unsolicited research proposal

—Existence of limited rights in data, patent rights, etc.

—Specified makes/models for standardization

—Utilities

—Shall not be used for initial acquisitions of equipment or spare parts.

—Unusual and Compelling Urgency

—Delay in award of contract would result in serious injury, financial or other, to the government

—Purchase requests citing an issue priority designator under the UMMIPS of 4 or higher, or citing "electric warfare QRC priority" may justify other than full and open competition

—Examples of exceptions provided at DFARS 206.302-2(b).

—Industrial Mobilization; or Experimental, Developmental, or Research work

—To maintain facility, producer, manufacturer, or other suppliers available for furnishing supplies/services in case of national emergency or to achieve industrial mobilization base

—To establish/maintain essential engineering, research or development capability to be provided by an educational or other non-profit institution or a federally funded R&D center

—Examples of exceptions are provided at FAR 6-302-3(b).

—International Agreements

—Precluded by international agreement or treaty between the United States and foreign governments

—Acquisition is to be reimbursed by a foreign country that specifies a certain firm in letter of offer/acceptance

—Acquisition is for supplies to be used in, or services to be performed in, the sovereign territory of another country and terms of treaty limit sources.

—Authorized or Required by Statute

—Federal prison industries

—Qualified non-profit agencies for blind or severely handicapped

—Government printing and binding

—Utility services

—Brand name commercial item for authorized resale.

—National Security

—Disclosure of agency needs would compromise the national security unless the agency is permitted to limit the number of sources from which it solicits bids/proposals.

—Public Interest

—When agency head determines that full and open competition is not in the public interest (for special written determination and congressional notification requirements associated with this exception see FAR 6.320-7(c)).

VII. JUSTIFICATIONS

—Contracting officer shall not commence negotiations for a sole-source contract, commence negotiations for a contract resulting from an unsolicited proposal, or award a contract without full and open competition unless the contracting officer:

—Justifies in writing

—Certifies accuracy and completeness of justification

—Obtains approvals required by FAR 6.304

—Technical and requirements personnel are responsible for providing, and certifying as accurate and complete, necessary data to support their recommendation for other than full and open competition

—Justification for unusual and compelling urgency may be prepared and approved after contract award

—Except for public interest, justification may be made on a class basis (see FAR6.302-7).

VIII. CONTENT OF JUSTIFICATIONS

Each justification shall, as a minimum, contain the following information:

—Identification of the agency and the contracting activity and specific identification of the document as a "justification for other than full and open competition

—Nature and/or description of the action being approved

—Description of supplies/services (including estimated value)

—Statutory authority

—Demonstration of proposed contractor's unique qualifications or the nature of the acquisition which requires use of the authority cited

—Description of efforts made to ensure that offers are solicited from as many sources as practicable

—Determination by contracting officer that anticipated cost to the government will be fair and reasonable

—Description of market survey conducted and results, or a statement of the reasons a market survey was not conducted

—Other facts supporting the use of other than full and open competition

—A listing of the sources, if any, that expressed in writing an interest in the acquisition

—A statement of the actions, if any, the agency may take to remove or overcome barriers to competition before subsequent acquisition for the supplies/services required

—Contracting officer certification that the justification is accurate and complete to the best of the contracting officer's knowledge and belief

—Recommendations by technical and requirements personnel for other than full and open competition must have been reviewed and approved at an appropriate management level in accordance with agency procedures before submittal to the contracting officer.

IX. APPROVAL LEVELS

—Up to $100,000, a level above the contracting officer

—$100,000 to $1,000,000, procuring activity competition advocate (cannot be delegated)

—$1,000,000 to $10,000,000, head of procuring activity or Flag/SES delegate

—Over $10,000,000, agency senior procurement executive (cannot be delegated)

—Class approval level at total estimated value of class

—Justifications required and related information shall be made available for public inspection. Contracting officers shall screen all justifications for contractor proprietary data and remove it before disclosure.

X. MISCELLANEOUS

—Acquisition Planning

—FAR 7.103(a) and (b) define agency-head responsibilities

—FAR 7.104(c) requires planner to coordinate with and secure concurrence of the contracting officer and competition advocate in all acquisition planning

—FAR 7.105(b)(1) and (2)-Sources and competition topics to be addressed to the plan:

—Market surveys

—Competition plans and appropriate FAR 6.302 authority

—Breakout

—Spare and repair parts.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Business Management Department
Number 3.2
Version: Original/Current
Date: December 1988

I. TITLE

Multiyear Procurement

II. REFERENCES

—Deputy Secretary of Defense Memorandum of 1 May 1981, "Policy Memorandum of Multiyear Procurement."

—Deputy Secretary of Defense Memorandum of 8 Oct 1981, "Funding of Multiyear Procurements"

—Federal Acquisition Regulation, Part 17, "Special Contracting Methods"

—DOD Federal Acquisition Regulation Supplement, Part 217, "Special Contracting Methods, Subpart 217.1—Multiyear Contracting

III. POINTS OF CONTACT

Office of the Secretary of Defense
Deputy Under Secretary (Acquisition Management)
Washington, D.C.
(202) 695-7145; AV 225-7145

Headquarters U.S. Army Materiel Command (DRCOPP-M)
5001 Eisenhower Avenue
Alexandria, VA 22333
(703) 274-8340; AV 284-8340

Headquarters U.S. Air Force
AF/RDCW
Washington, D.C. 20330
(202) 697-1417; AV 227-1417

IV. PURPOSE AND SCOPE

This fact sheet is designed to provide the following regarding multiyear procurement:

—Description and key terms
—DOD policy and background
—Procedures and application
—Advantages and disadvantages
—Congressional concerns
—Cost implications and concerns

V. DESCRIPTION OF MULTIYEAR PROCUREMENT

Multiyear procurement is a commitment in the first year to buy the entire quantity of some weapon system over several years, and to be funded over the same period of time. It differs from annual procurement since the entire quantity is indicated for procurement upfront, even though it is only going to be bought 1 year at a time. The annual procurement method buys only the number of end-items that are required for that particular year and makes no commitment to buy anything in future years.

VI. MULTIYEAR TERMS

The concept of multiyear procurement allows the use of a more flexible, tailored acquisition approach. Two key terms are found in most multiyear programs:

—*Expanded Advance Buy.* This term refers to the advance procurement of equipment and subassemblies to meet the multiyear procurement schedule. As opposed to normal advanced procurement practice, multiyear also allows advance procurement to obtain the best price (i.e., order in economic order lots) in addition to protecting schedule. It is possible to order the entire 5 year requirement of an item at one time if you have the budget authority to do so.

—*Cancellation Ceiling.* In the event that a multiyear must be cancelled it is necessary to know the total liability to the government. Usually, this term is known as termination liability, but under multiyear it is known as a cancellation ceiling.

When a multiyear program is intended to be cancelled, normally the program will be allowed to progress through the remainder of the fiscal year and then it is cancelled with no further procurement anticipated. Any further acquisition of this particular weapon system will then be done under annual procurements. The cancellation ceiling at this time for multiyear contracts is restricted to $20 million or less. Advance notification to the Congress is required for any multiyear program that is proposed with a cancellation ceiling greater than $20 million.

The Deputy Secretary of Defense memorandum of 1 May 1981 establish DOD policy on multiyear procurement. The fundamental premise underlying this policy statement is: "That quantity production contacts should be structured and funded whenever possible to benefit from economies of scale where such economies can be attained at an acceptable level of risk to both the government and the contractor." This memorandum details the criteria by which program managers can determine the appropriateness of their programs for multiyear applications, various funding concepts to be considered when tailoring their multiyear acquisition strategy, and the appropriate control procedure.

The DOD policies regarding the funding of multiyear procurements are stated in the Deputy Secretary of Defense memorandum of 8 Oct 1981. These policies state in part that contracts awarded under the multiyear procudeure shall be firm fixed price or fixed price with provisions for economic adjustment; and that multiyear procurement may be used for the procurement of property including weapons systems, services associated with weapons systems, logistic support systems, subsystems, major equipment requirements, parts materials, and advance procurement. This policy memorandum addresses specific actions required by the head of the contracting activity in the area of non-competitive contracting and of the specifications and limitations prior to the use of the multiyear method.

The program manager and the program office financial/contracting specialist should throughly familiarize themselves with the above policies to assist in their determining multiyear procurement candidates.

VII. BACKGROUND

Multiyear contracting has been in existence for many years within the DOD for smaller dollar purchases, for some areas of operations and maintenance, and for overseas operations and maintenance contractual requirements. Most other acquisitions for products and services, including procurement of weapons systems, were limited primarily to annual contracting or the exercise of annual options to the basic contract. In 1981 it was recognized that as a method for improving defense acquisition and increasing economy and efficiency of the acquisition process, the principle of multiyear contracting could be applied to the acquisition of weapon systems. However, a general awareness about this use of multiyear contracts was lacking within DOD.

Therefore, as part of the review of the acquisition process, the Deputy Secretary of Defense directed that a team be established to work on expanded multiyear concepts and procedures. The team was composed of financial managers, acquisition managers, and legal advisors. Its principal efforts were devoted to clarification of terms relating to multiyear procurement found to be ambiguous and confusing: development of flexible concepts could be used to meet different procurement situations; and, the development of budgetary control procedures for programs that are selected for multiyear procurement.

The team's effort resulted in the identification of several candidate programs for possible multiyear application and integration into the FY 83 program objective memorandum (POM).

Since that time, the federal acquisition regulation (FAR) has been implemented, which, in Part 17, "Special Contracting Methods," the subject of multiyear contracting is addressed and further amplified in the DOD FAR Supplement.

VIII. PROCEDURE

Multiyear contracting is a method of satisfying DOD requirements for up to a 5-year period (4 years in the case of maintenance and operation of family housing), without having total funds available at time of award. Multiyear contract quantities are budgeted for, and financed, in accordance with the applicable program year as reflected in the DOD five-year defense program. This method may be

used for competitive or noncompetitive contracting. With respect to competitive contracting, award may be based on price only, or price and other factors considered. The contractor is protected against loss resulting from cancellation by contract provisions allowing reimbursement of unrecovered nonrecurring costs included in prices for cancelled items. However, before any multiyear contract that contains a clause setting forth a cancellation ceiling in excess of $1 million may be awarded, the Secretary shall give written notification of the proposed contract and of the proposed cancellation ceiling for that contract to the committees on Armed Services and Appropriations of the Senate and House of Representatives; and, such contract may not then be awarded until the end of a period of 30 calendar days beginning on the date of such notification. A copy of the notification shall be submitted to OUSDRE (AM).

IX. APPLICATION OF MULTIYEAR PROCUREMENT

The application of multiyear procurement to a DOD program involves all levels of management. Close cooperation among program, system, and support managers, and contracting and financial specialists is required to ensure its' proper implementation. The economies and efficiencies of multiyear contracts shall be balanced against risks from unstable operation, technical design or quantity requirements. Early planning is required to ensure that adequate funding is provided for in the DOD programming and budgeting documents.

The process of deciding to use, or not to use, the technique of multiyear procurement for production requires a benefit risk analysis using criteria as stated in enclosure 2 of the May 1981 Deputy Secretary memorandum on multiyear procurement, which is quoted here in full:

—*Benefit to the Government.* A multiyear procurement should yield substantial cost avoidance or other benefits when compared to conventional annual contracting methods. Multiyear Procurement structures with greater risk to the government should demostrate increased cost avoidance or other benefits over those with lower risk. Savings can be defined as significant either in terms of dollars or percentage of total cost.

—*Stability of Requirement.* The minimum need (e.g., inventory or acquisition objective) for the production item or serivce is expected to remain unchanged or vary only slightly during the contemplated contract period in terms of production rate, fiscal year phasing, and total quantities.

—*Stability of Funding.* There should be a reasonable expectation that the program is likely to be funded at the required level throughout the contract period.

—*Stable Configuration.* The item should be technically mature, have completed RDT&E (including development testing or equivalent) with relatively few changes in item design anticipated and underlying technology should be stable. This does not mean that changes will not occur but that the estimated cost of such changes is not anticipated to drive total costs beyond the proposed funding profile.

—*Degree of Cost Confidence.* There should be confidence that the potential contractor(s) can perform adequately, both in terms of government furnished items (materials, data, etc.) and their firm's capabilities. Potential contractors need not necessarily have previously produced the item.

—*Applicable Considerations.* It requires a great deal of time to properly structure a multiyear program. In the event a particular weapon system meets all of the criteria to be a multiyear candidate, then the program manager and his staff must put together a justification package and submit it through channels to the Department of Defense. The justification package consists of a number of different items, all of which are intended to justify the weapons system as a multiyear candidate. The package consists of:

—Criteria and risk assessment
—Cost comparison between multiyear and annual procurement
—Inflation change assessment
—Explanation of savings and/or cost avoidance
—Present value/discounted cash flow analysis
—Impact on industrial base

X. ADVANTAGES AND DISADVANTAGES IN MULTIYEAR PROCUREMENT

The advantages of multiyear procurement strongly outweigh merits of the more conservative and traditional approach to weapons system procure-

ment, which are now employed. The use of multiyear procurement for weapon system acquisition takes advantage of one or more of the following:

—Lower costs

—Enhancement of standardization

—Reduction of administrative burden in the placement and administration of contracts

—Substantial continuity of production or performance, thus avoiding annual start-up cost, preproduction testing cost, make-ready expenses, and phase-out cost.

—Stabilization of work forces

—Broadening the competitive base with opportunity for anticipation by firms not otherwise willing or able to compete for lesser quantities, particularly in cases involving high start-up costs

—Implementation of the industrial preparedness program for planned items with planned producers

—Provide incentives to contractors to improve productivity through investment in capital facilities, equipment, and an advanced technology.

The major disadvantage to using multiyear procurement is in the area of decreased flexibility in the annual budgeting, authorization, and appropriation process. Long-term commitments add to risks assumed by the contractor and the government. However, inherent increased risk associated with inability to conduct annual review and make annual adjustments to the program can be ameliorated by the selective use of multiyear procurements coupled with a thorough benefit/risk analysis.

XI. CONCERNS

There are several areas of congressional concern regarding multiyear procurement. Due to the provisions for expanded advance buy, multiyear programs normally require more money upfront than do annual procurement programs. In addition, there is usually a large cancellation ceiling in the early years. This contributes to the problem of trying to assign priorities and appropriate a limited amount of budget authority for defense programs. A second area of concern in the Congress is reduced flexibility. It is common knowledge to people in the acquisition environment that it is expensive to cancel a multiyear program. Therefore, once a multiyear program is started it is generally wise to finish it. This makes the budget less flexible because large blocks of money, now tied up for multiyear programs, are not available to be used elsewhere. The Congress would like to have proposed each year a full funded program for the systems procured in that year, as well as full funding for advance buy, and the cancellation ceiling. This is necessary so that the Congress would know, in its reviews of the budget, the total price of the program in case of cancellation. Another area in which the Congress is interested concerns guaranteed deliveries. Each year the Congress would like to have deliveries from a multiyear program. If a multiyear program is proposed with no deliveries whatever in the first year, it will have difficulty getting through the congressional cycle.

XII. COST IMPLICATIONS

The benefits derived from multiyear procurement essentially fall into three catagories: reduced cost, early deliveries, and program stability. Through the use of economic order quantitites and expanded advance buy, the government is able to realize significant savings in the procurement of materials needed for the program. These earlier procurements may allow the defense industry to consolidate the schedules and accelerate their production deliveries. The final area of program stability comes from the up-front commitment to buy the entire quantity over a 5-year period. It allows the PCO to obtain a negotiated price for the end-item over the 5-year period, and to establish quantity and delviery schedules. These benefits are not without problems.

XIII. CURRENT MULTIYEAR ISSUES

Funding the Cancellation Ceiling. Since multiyear programs tie up a large amount of budget authority, the Department of Defense has proposed that the cancellation ceiling not be funded, since multiyear programs normally have a low probability of being cancelled. This would allow defense to require less budget authority for the multiyear programs, and have more funds available to budget for other programs.

Substantiation of the Proposed Savings. The General Accounting Office has done several studies on multiyear and concludes that the defense department will not realize the savings proposed. As a result, program managers have been directed to obtain two firm quotes from the contractor

whenever attempting a multiyear program (one for multiyear and one for annual procurement).

Budget Flexibility. Both the Defense Department and the Congress are concerned that multiyear ties up too much budget authority and reduces the amount of the defense budget left to fund the rest of the programs being pursued.

XIV. Conclusion

It is apparent that DOD can realize savings through multiyear procurement of weapons systems. Though not a panacea for many of the ills in the acquisition process, applied with discretion it can go a long way toward improved system stability and reduced costs.

FACT SHEET PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Business Management Department
Number: 3.3
Version: Update
Date: November 1988

I. TITLE

Request For Proposal (RFP) Preparation

II. REFERENCES

—Federal Acquisition Regulation (FAR) Subpart 15.4, Solicitation and Receipt of Proposals and Quotations"

—DOD Directive 4105.62, "Selection of Contractual Sources for Major Defense Systems"

—Military Handbook 245B, "Preparation of Statement of Work (SOW)"

III. POINTS OF CONTACT

—Local contracting offices

IV. PURPOSE AND SCOPE

—Provides information on purpose and preparation of an RFP
—Summarizes related DOD policy
—Describes RFP content and organization
—Outlines common RFP complaints
—Suggests ways to improve the RFP process

V. DOD POLICY

DODD 4105.62 (see references above) contains governing DOD policy on RFP preparation. Among key points:

—*Minimize government and competitor expense.* RFPs (or solicitations) should be designed to minimize competitor and government expense associated with preparing them and responding to them.

—*Page limitations.* Page limitations for both the solicitation and response are encouraged, provided completeness is not sacrificed.

—*Requirements and goals.* Technical requirements in the RFP may be stated as goals, acceptable values, or as bands of acceptable values in cases where tradeoffs can be made.

—*Alternate designs vs. technical approach.* In the early stages of system development, the selection of a competitor(s) is frequently made from among alternative system design concepts. Under these circumstances, the solicitation should be structured to reflect such factors as mission need, capability objectives, operating constraints, schedule and cost, but *not* technical approach or design features.

—*Risk Management.* The RFPs shall require that competitors identify technical risks and uncertainties and suggest realistic approaches to resolve, or avoid, these risks.

—*Review Boards.* Review boards shall be established to review thoroughly the RFP for consistency with law, policy, regulations, and key program documentation such as the decision coordinating paper and source selection plan.

—*Source Selection Evaluation Criteria.* The RFPs shall identify the evaluation criteria against which all proposals submitted will be evaluated. These criteria are the same as those contained in the source selection plan, which *must* be approved before RFP release.

VI. FUNDAMENTALS

—Background

When the Army Signal Corps sought to purchase the development of an aircraft from the Wright brothers, it issued a request for proposal that was

Figure 1. PROCUREMENT METHODS AND SOLICITATIONS

PROCUREMENT METHOD	SEALED BIDS ·Preferred· (formerly, "Formal Advertising")	COMPETITIVE PROPOSALS (formerly, "Negotiation")
Solicitation	IFB Invitation for Bids	RFP Request for Proposal

only one page in length. The ensuing fixed-price incentive contract, which filled only 2 pages, resulted from a 40-day competition among 41 bidders. After a 9-day government evaluation period (source selection), an award was made and the aircraft flew successfully some 6 months later. (As related by Norman Augustine in *Augustine's Laws*, American Institute of Aeronautics and Astronautics, Inc., 1982.)

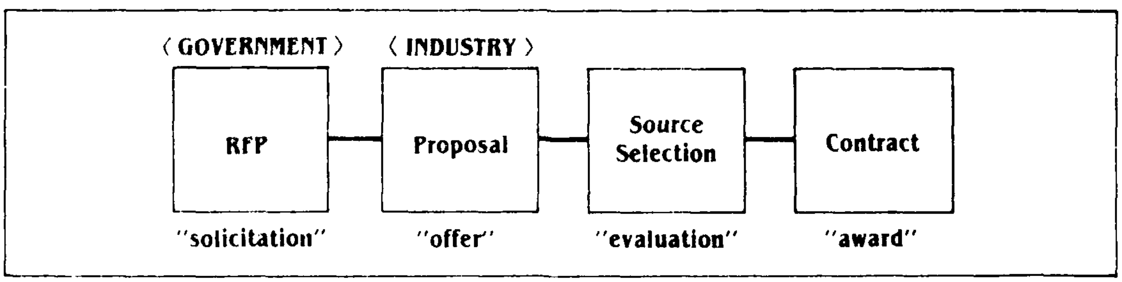
Today's government contracting is remarkably similar in its fundamentals. The solicitation process, however, has become notably more complex. Several years ago, for example, *Aviation Week and Space Technology* reported that the Air Force had issued an RFP for the next generation trainer (NGT) program, which ran 2,700 pages, plus amendments. Even without amendments, it stood more than 6 inches high. Much of the bulk was contracting "boilerplate," but the RFP reportedly contained 400 pages of specific requests for data that took one respondent more than 4,000 pages to answer—at a cost of $2-3 million.

—Solicitations

If the government solicitation process has indeed become more complex over the years, its basic purpose is essentially the same. In its simplest terms, the solicitation is the vehicle by which the government advertises to industry its desire to purchase goods or services (development effort, equipment, weapons, studies, commodities, etc.).

The solicitation generally takes one of two major forms. As summarized in Figure 1, if sealed bids are used (overall preferred method), the solicitation instrument is called the invitation for bids (IFB). Systems acquisitions, however, which are more typically the domain of DOD program managers, generally use the competitive proposals method of procurement in which the RFP (subject of this fact sheet) is the solicitation instrument. One other solicitation instrument of note is the request for quotation (RFQ). An RFQ may be used when the government does not immediately intend to award a contract based on responses, but wishes

Figure 2. RFP IN THE CONTRACTING PROCESS



to obtain preliminary responses for subsequent contract discussions and negotiation. Thus, a quotation received in response to an RFQ is not an official "offer" and cannot be accepted by the government to create a binding contract.

RFPs in the Contracting Process

The RFP is a formal, official communication between government and industry in the contracting process. Figure 2 shows a simplified outline of the process.

When the government issues an RFP, it is describing its needs for particular goods or services, and is soliciting from industry proposals to fulfill those needs. Competitors (or offerors) submit proposals (or offers) in response. Subsequently, the government conducts a source selection, and the contracting officer signs (accepts) to award a binding contract.

The RFP has particular significance in this process in that the clarity and coherence with which it is constructed can dramatically affect the events that follow—favorably or unfavorably. How well the government clearly communicates its needs in the RFP, for instance, will almost certainly influence the quality of proposals received, ease of difficulty of conducting source selection and negotiation and, ultimately, relative success or failure of contract performance.

VII. FORMAT AND CONTENT

The Federal Acquisition Regulation (FAR) usually requires that contracting officers prepare written solicitations and resulting contracts using the uniform contract format outlined in FAR 15.406-1. That section also outlines a few exceptions when the uniform contract format is optional, such as for shipbuilding and construction. The uniform con-

Figure 3. UNIFORM CONTRACT FORMAT ((Source: FAR 15.406-1)

Part I - THE SCHEDULE		MODEL CONTRACT
Sec. A	**Solicitation/Contract Form**	
B	**Supplies or Services and Prices/Costs**	
C	**Description/Specifications/Work Statement**	
D	**Packaging and Marking**	
E	**Inspection and Acceptance**	
F	**Deliveries or Performance**	
G	**Contract Administration Data**	
H	**Special Contract Requirements**	
Part II - CONTRACT CLAUSES		
I	**Contract Clauses**	
Part III - LIST OF DOCUMENTS, EXHIBITS, ATTACHMENTS		
J	**List of Attachments**	
Part IV - REPRESENTATIONS AND INSTRUCTIONS		
K	**Representations, Certifications, Statements**	
L	**Instructions, Conditions, Notices to Offerors**	
M	**Evaluation Factors for Award**	

tract format, shown in Figure 3, is designed to facilitate preparation of both the solicitation and the resulting contract. Each section fulfills a specific purpose:

—*Section A - Solicitation/Contract Form*, cover sheet (for an RFP, it is a Standard Form 33) that contains basic information such as the issuing office, address, and contract number

—*Section B - Supplies/Services/Prices/Costs*, brief description of each contract deliverable (item, quantity, etc.), each covered by a contract line item number (CLIN). Prices are entered subsequent to solicitation

—*Section C - Description/Specifications/Work Statement*, actual tasks to be completed in performance of the contract and associated specifications including the statement of work (SOW)

—*Section D - Packaging and Marking*, special packaging/marking requirements such as preservation, protection and bar-coding

—*Section E - Inspection and Acceptance*, place of inspection, who will inspect, and acceptance criteria

—*Section F - Deliveries or Performance*, the time, place, method of delivery, or performance

—*Section G - Contract Administration Data*, accounting and paying office information

—*Section H - Special Contract Requirements*, requirements unique to your program and this contract; i.e., design to unit production cost (DTUPC), warranties, options, government furnished equipment (GFE), and incentives.

—*Section I - Contract Clauses*, commonly referred to as "boilerplate" and not to be overlooked; include standard clauses of considerable power defining rights and responsibilities of contracting parties

—*Section J - List of Attachments*, all attached forms and specifications listed here and also including DD Form 1423, contract data requirements list (CDRL) for all data deliverables

****

MODEL CONTRACT - Sections A through J (Parts I-III) contain documents that, in effect, constitute a draft or "model contract." In fact, the purpose of structuring the RFP this way is to provide basic documentation that will eventually form a major part of the resultant contract.

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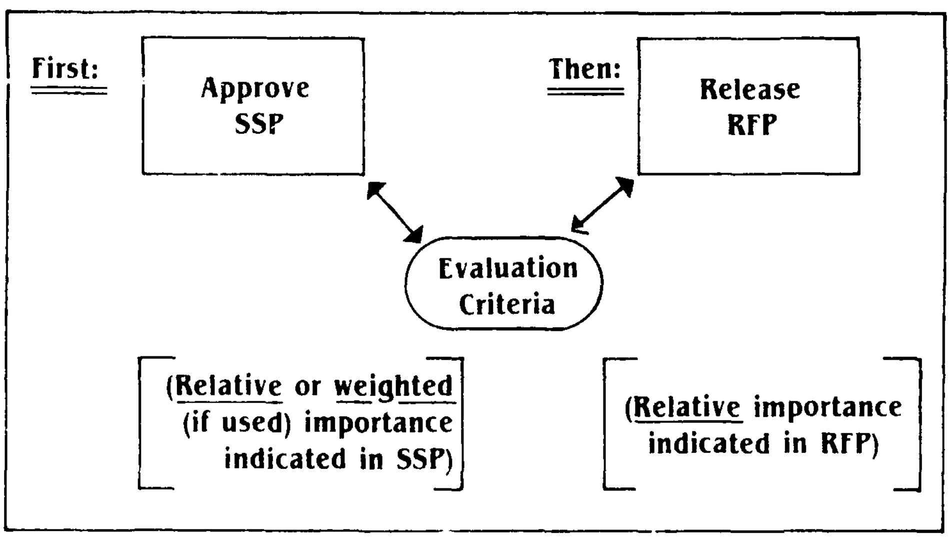
The remaining sections (Part IV) in the uniform contract format are important parts of the RFP, but are not physically included in the resulting contract.

Figure 4. RFP AND THE SOURCE SELECTION PLAN



—*Section K - Representations, Certifications*, any special representations required of offerors, such as small/disadvantaged business status, or EEO compliance

—*Section L - Instructions, Conditions, Notices to Offerors*, how to organize proposal (volumes, page limits), type contract contemplated, where to obtain copies of documents, marking proprietary information

—*Section M - Evaluation Factors for Award*, how the government intends to evaluate proposals; these factors are the same as those in the source selection plan (SSP), which must be approved before RFP release (see Figure 4); typical factors or "evaluation criteria" include schedule, management, technical approach, and support; factors may be assigned numerical weights in the SSP to reflect importance assigned by the government but only *relative* importance is revealed in the RFP.

VIII. COMMON COMPLAINTS

—*Length*. The length of RFPs has been a chronic complaint. The C-5 aircraft RFP, for example, numbered 2,800 pages including clarifying supplements, and generated a proposal of some 1½ million pages. By imposing reasonable page limits, the program manager and contracting officer are in key positions to control and balance voluminous inputs to the RFP from various functional areas.

—*Clarity*. A lack of clarity in RFPs is another often cited shortcoming. Watch for information that is not clear or is contradictory. Are key objectives buried or obscured? Beware of people who say: "We'll clarify that during negotiations."

—*Too Much Information Requested*. By all means, ask for what is important, but ask what is *really* needed to select the rightful winner in an intelligent way.

—*Timing of Release*. Some accuse the government of habitually releasing RFPs to industry for December proposal efforts. Holiday schedules are certainly one consideration in the timing of RFP release. Watch for compressed schedules in long-term planning. For instance, will needed test data from one development phase be available in time to prepare the RFP for the next phase in the acquisition cycle?

—*Cost*. High costs associated with responding to complex RFPs is another recurring complaint. Several years ago, the *Wall Street Journal* reported that McDonnell Douglas Corporation spent an estimated $40 million in preparing proposals for the C-X transport aircraft program. Program managers and contracting officers may be key judges in weighing the merits of including RFP requirements that invariably generate workload and costs.

—*Realistic Requirements*. On major programs, industry knows how much funding is available or that the Congress is willing to provide. Technical proposal requirements should be consistent with available contract funds.

IX. SUGGESTED IMPROVEMENTS

Many suggestions made over the years have helped improve the RFP process. Among those that have been particularly helpful:

—*Draft RFPs*. These are circulated in advance to industry for comment and have been increasingly popular. A draft RFP is not a formal solicitation and may be circulated for comment before the SSP is approved. The idea is to encourage suggestions and challenges. Has the government unknowingly created significant cost drivers? Is adequate contractor ingenuity allowed? Are data requirements excessive? Recently, the advanced tactical fighter program issued a draft RFP that generated some 1,450 potentially helpful comments. One caution is in order here: Draft RFPs are not miracle cures for unrealistic requirements, or schedules where industry may be understandably reticent to provide feedback that could appear non-responsive or, perhaps, endanger a perceived competitive advantage.

—*Murder Boards*. These are an extension of the review board concept described above in the DOD Policy Section V. As the name implies, the board provides an independent review of the entire solicitation, typically challenging provisions and providing suggested changes, additions, or deletions from perspectives that can range from "constructive critic" to "devil's advocate."

—*Evaluation Criteria*. Many program offices have been able to enhance the quality of their RFPs by taking particular care in selecting evaluation

criteria. The key here is carefully choosing criteria that will be true discriminators in helping to differentiate among proposals. A critical question to ask: "Will this factor help me select a winner?"

—Internal/External Consistency. The tendency toward length and complexity in RFPs is further complicated because they typically represent individual inputs from many functional specialities in a program office. Thus, a special review for internal and external consistency can have potentially high payoffs. Internally, requirements in one section of the RFP should agree with those in another. For example, if the CDRL includes a logistics support analysis as a deliverable, you should also find a task in the SOW requiring the contractor to prepare that analysis. Externally, the RFP should be consistent with documents like the program management plan.

—Executive Summary

An executive summary of the RFP can be a useful introduction and overview for senior management in government and industry. A good summary might place in context the intended contract as one part of a larger program with several planned phases of development and production. Moreover, the summary can highlight for senior management a particular aspect of the program that is critically important.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Business Management Department
Number 3.4
Version: Original/Current
Date: December 1988

I. TITLE

The Role of the Statement of Work (SOW) in Program Management

II. REFERENCES

—Military Handbook 245B
Preparation of Statement of Work (SOW)

—USDRE Memorandum, Subject: "Statement of Work (SOW)"

III. POINT OF CONTACT

Naval Space and Warfare Systems Command
Department of the Navy
Washington, D.C. 20363
ATTN: SPAWAR 8111
(202) 692-3877

HQ, USAF System Command
(HQ, AFSC/PKP)
Andrews AFB, MD
(301) 981-6433; AV 858-6433

HQ, US Army Materiel Command
5001 Eisenhower Ave.
Alexandria, VA 22333
(202) 274-8335; AV 284-8335

IV. PURPOSE AND SCOPE

—To provide an executive summary of Military Handbook 245B

—To summarize the process of preparation of the Statement of Work (SOW)

V. DOD POLICY

A clear statement of contract requirements is a prerequisite for defining and achieving program goals. The statement of work (SOW) provides the basic framework for this effort.

VI. DOD REQUIREMENTS AND GUIDELINES

The objectives of the Department of Defense in Military Handbook 245B are to:

—Provide a broader base of proposers/contractors resulting from complete, clear statement of requirements and risk identification

—Reduce delays in source selection by reducing or elimating the need to go back to proposers for additional information on qualification, etc.

—Minimize contractors "building in" contingency allowances resulting from unclear requirements

—Enhance the quality and inventiveness of proposals

—Reduce proposal size, cost, and preparation time

—Aassist in the proper selection of contract type (e.g., incentives versus cost plus fixed fee (CPFF) depending upon quantification of requirements and their measurement as opposed to uncertainty with respect to performance, cost goals, and time

—Simplify determining the rights of the contractor and the government.

VII. SOME FIRST PRINCIPLES

—Statement of Work (SOW). A document that defines efforts to be accomplished ranging from a small research study to the acquisition of an operational inventory of a new major weapon system. It establishes non-specification tasks/requirements and identifies the work effort as minimal needs. The language defines the scope or outer limits of the contractor's effort. Various terms are used to identify this document (SOW, work scope, technical requirement, system description).

Text of the SOW tasks shall not generally include the description and delivery requirements for data. The SOW is part of the request for proposal (RFP) and the contract. It is a key element of the RFP and serves as a basis for contractor response, and government evaluation of proposals in source selection. After contract award, requirements of the work statement (and associated specifications) constitute the standard and discipline for the contractor's effort. It comprises the baseline against which progress and subsequent contractual changes are measured. Both parties will look to the language of the statement of work, as modified, as a key document defining responsibilities of the contractor.

—Responsibility for SOW Preparation. Responsibility for work planning within DOD rests with those offices responsible for work accomplishment; i.e., the program management office. One important facet of program planning is the preparation of the SOW as the SOW defines the work effort required from contractors and DOD support activities to support DOD programs. One person should have the responsibility for the complete SOW. With responsibility assigned to an individual along with proper planning/scheduling, an appropriate development approach, and preparation for the SOW including editing, can be expected. Several contributors are typically involved in the development and preparation of a SOW; numerous reviews and audits of a SOW are parts, of the preparation process. Without assignment of responsibility in entirety to a single preparer, a fragmented, internally inconsistent and incomplete document is likely to result.

VIII. TYPES OF SOW

Five types of Statement of work are defined. Four are associated with the phases of the life-cycle process. The fifth, for services, is independent of defense material procurement phases and won't be discussed in this fact sheet.

Type I (concept exploration/definition) is required when the technical requirements are defined in the SOW. Efforts in this phase are stated in terms of objectives or goals to be sought rather than as specific quantitative or qualitative tasks in specifications. Normally a specification does not exist. Within the type I SOW technical data or technical reports resulting from work tasks defined in the SOW are discussed and ordered; the nature of this type of effort normally results in a technical report. Where the SOW effort would generate data desired by the government, the data is specifically listed on a contract data requirement list (CDRL) (see Figure 7, MIL-HDBK-245B, for sample Type I SOW for concept exploration/definition concept phase).

Type II (Demonstration/Validation) is required when the technical work tasks are expressed objectively *or* as goal attainment. A specification or technical document is permitted. Technical data requirements are established by using the contract data requirement list (CDRL); normally there is a requirement to deliver some defense material (see Figure 8, MIL-HDBK-245B, for sample Type II SOW for concept demonstration/validation phase).

Type III (full-scale development) is required when a purchase description (contract specification) is used to define qualitative and quantitative technical requirements including the respective quality provisions. In addition to the contract specification, the SOW is used concurrently to indicate the need for various system effectiveness program tasks, publications, training, integrated logistic support requirements, configuration management requirements, management systems, supply support tasks (provisioning), quality program ordered in this phase, as in the previous phase, with the CDRL (see Figure 9, MIL-HDBK-245B, for sample Type III SOW for full-scale development phase).

Type IV (Production and Deployment) is required when fulfilling the need for the production and deployment phase consummating the end efforts of the research and development (R&D) phases. The contract specification may be converted to a military specification. A Type IV SOW is used to order the same type of non-qualitative and non-quantitative elements as in previous phases, now scoped to minimal needs serving this contract phase. Technical data is ordered using the CDRL (see Figure 10, MIL-HDBK-245B, for sample Type V SOW for non-personal services)

IX. CONTENTS OF THE SOW

SOW Format. The standard format for the SOW is:

Section	Title
	Title Page and Table of Contents
1	Scope
2	Applicable Documents
3	Requirements

—Title page and table of contents identifies SOW title, preparation completion date, preparing organization, sections/paragraphs of the SOW, and page numbers. A table of contents is required when the SOW exceeds five pages.

—Scope section states briefly what the SOW covers, along with any background. Never include direction to the proposer(s)/contractor(s) to perform work tasks or discussion of data requirements or deliverable products.

—Applicable documents section. Applicable documents are listed to aid proposer(s)/contractor(s) to determine the documents that must be fully understood when they are invoked in the requirements section of the SOW.

—Requirements section defines the work or task efforts. Requirements may be mandatory, desirable, optional, or have alternatives. A systematic, logical arrangement, preferably in chronological order, of the required work is desired (the work breakdown structure (WBS) is an example of logical arrangement). A particular benefit in using WBS is that it presents a uniform approach to structuring the program, which, in turn, allows the various functional specialists involved to draw on the efforts of each other.

X. WRITING THE SOW

—The work to be accomplished must be expressed in work words (see Appendix Z, Mil Hdbk 245B, for work words).

—When a requirement is mandatory, the word "shall" is used. The word "will" is used as a declaration of purpose or statement of futurity; it does not mean that the requirement is mandatory.

—Clear writing in ordinary language is imperative. Words that permit more than one interpretation should be avoided. Essential technical language should be used sparingly. Use the active voice instead of the passive voice. The statements of work/task efforts should be clear enough to permit cost estimates to be made, and to enable the proposers to determine the levels of expertise, manpower, and other resources needed to accomplish the effort. The language should convey precisely what is required so that the contractor is clear as to what he should do, and the contract administration officer (CAO) can determine compliance by the contractor.

—Ordering and delivery of data are done through the use of the contract data requirements list (CDRL, DD Form 1423) in conjunction with an appropriate data item description (DID, DD Form 1664). Use the DID to describe the data and prescribe the preparation instructions in terms of format and arrangement. In the case of Type I SOW (concept exploration), technical data or technical reports resulting from work tasks defined in the SOW are also discussed and ordered within this SOW as the nature of this type of effort normally results in a technical report.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Business Management Department
Number: 3.5
Version: Update
Date: November 1988

I. TITLE

Source Selection Plan

II. REFERENCES

—Federal Acquisition Regulation (FAR) Subpart 15.6, "Source Selection"

—Department of Defense Directive (DODD) Number 4105.62, "Selection of Contractual Sources for Major Defense Systems"

—DOD FAR Supplement Subpart 215.6, "Source Selection" 1988

—AFR 70-15, "Proposal Evaluation and Source Selection"

—AR 715-6, "Proposal Evaluation and Source Selection

—NAVMAT INST. 4200.49, "Selection of Contractual Sources for Major Defense Systems"

III. POINTS OF CONTACT

—Local Contracting Office
—Office of the Under Secretary of Defense, Research and Engineering, Deputy Under Secretary (Acquisition Management)

IV. PURPOSE AND SCOPE

—To describe the source selection plan used in competitive acquisitions involving an evaluation and comparison of cost or price and other factors for source selection.

V. DEFINITIONS

—Source Selection Authority (SSA) means the government official in charge of selecting the source.
—Source Selection Advisory Council (SSAC) is a group of senior military and/or government civilian personnel designated to serve as the staff and advisor to the SSA authority during the process.
—Source Selection Evaluation Board (SSEB) is a group of military and/or civilian personnel appointed by the SSAC representing various functional and technical disciplines, to evaluate proposals and develop summary facts and findings during the process.

VI. DOD POLICY

The prime objectives of the source selection process are to (1) select the source whose proposal has the highest degree of realism and credibility and whose performance is expected to best meet government objectives at an affordable cost, (2) assure impartial, equitable, and comprehensive evaluation of competitors' proposals and related capabilities, and (3) maximize efficiency and minimize complexity of solicitation, evaluation, and the selection decision.

The source selection plan establishes procedures for accomplishing the prime objectives. Prior to the issuance of a solicitation, a source selection plan shall be approved by the SSA. The program manager is responsible for drafting the plan and obtaining its approval from the SSA

VII. SOURCE SELECTION PLAN

The plan should complement the acquisition plan and should summarize the overall acquisition strategy contemplated for the requirement. The plan should include a discussion of the extent of competition contemplated, a description of the evaluation techniques to be used, and the schedule for significant actions required between the designation of the SSA and signing of the definitive contract. A typical plan will address, as a minimum, six primary areas, which are discussed below.

—*Description of the Organizational Structure*. The organization is normally composed of three levels: the SSA, the SSAC and the SSEB.

—The SSA, normally the service secretary for major systems, is responsible for the overall source selection activity. This includes approval of the plan, establishing the membership of the SSAC, and making the final selection decision.

—The SSAC comprises senior military and/or civilian management. The SSAC is responsible for appointing the membership of the SSEB, establishing and applying the evaluation criteria and the numerical weighting (scoring scheme) for these criteria. It reviews the SSEB findings, prepares a proposal analysis of each offer and compares the proposals to one another. The SSAC is the body that considers the contractors' past performances. The output of the SSAC is a formal report to the SSA on SSAC evaluations.

—The SSEB is the heart of the selection team. The SSEB evaluates the proposals and provides the narrative findings to the SSAC for use in their review. The leadership of the SSEB should be an area of importance to the program manager. The SSEB will be made up of a cross-section of expertise from within and without the organization. The manning would typically include personnel from logistics, cost analysis, operational, contract, legal and technical areas.

The personnel assigned to the source selection team, where possible, are designated by name in the plan.

—*Proposed Preselection Activities*.

This section will identify and define any presolicitation contact planned by the government with the possible proposal sources. This will ensure the source selection team is cognizant of what was done and what the implications may be with regard to the proposals submitted. Also addressed will be the actions required by the team prior to the source selection, including a plan for preparing the solicitation, and establishing a board to review the solicitation prior to its release.

—*A Summary of the Acquisition Strategy*. The purpose of this section is to provide the team members a review of the program peculiar aspects. Included here would be the number of contractors to be carried through a program phase, and plans for concurrency or elimination of development phases that may impact on the source selection process.

—*A Statement of the Proposal Evaluation Factors and Their Relative Importance*. The significance of this section is twofold. One is to establish the criteria against which the source selection team will evaluate the proposals. The other is to express—in the solicitation—to the contractors intending to make proposals what areas are of most importance to the government. This allows the contractor to formulate a proposal that is responsive and ensures goverment requirements are addressed. Included are general considerations such as the ability of the source to provide a quality product, the adequacy of the design to meet the requirement, and the reasonableness and realism of the cost proposal. In addition, specific evaluation criteria are listed in order of importance. Typical criteria include technical aspects, operational considerations, supportability, management capabilities, and cost analysis. Examples of each area are shown in Table 1.

—*A Description of the Evaluation Process, Methodology and Techniques To Be Used*. This section sets forth the structure and procedures for completing the evaluation. It will specify how the SSEB members will be grouped in order to evaluate the proposals. For example, the evaluation areas will be divided into subareas and further subdivided to specific items such as found in the work-breakdown stucture of the system. It is at this lowest level that the evaluation criteria will be applied and then aggregated up to the total system. It is important to note that the proposals are only evaluated against the solicitation requirements and the evaluation criteria and not each other. Once the evaluation is complete, the SSEB will formulate a narrative of their findings that addresses the con-

Table 1. REPRESENTATIVE EXAMPLES FOR CRITERIA AREAS

AREA	EXAMPLES
Technical	—Design approach —Test plan —Performance criteria —Design innovation
Operational	—Approach to operational concept —Maintainability —System capability
Supportability	—Impact on current logistics systems —Maintenance concept —Supply support
Management	—Integration procedures —Interface procedures —Schedule adherence —Program control techniques —Past performance
Cost	—Risk —Labor and overhead rates —Development costs —Life-cycle cost —Cost realism

tents of the proposals, where they failed to meet the requirements (with the needed corrections), and what impact there would be on the proposal's suitability if the corrections are made. These findings are then provided and briefed to the SSAC for its review.

—*A Schedule of Significant Milestones*. The timeliness of the source selection process is important. All too frequently, the schedule is violated and the resulting delay proves to be a disservice to both government and industry. The milestone schedule should drive the process to completion. Additionally, it ensures all required events are considered.

Figure 1. SOURCE SELECTION PLAN PREPARATION CHECK LIST

—Determine SSA
—Determine membership of SSAC
—Determine SSEB chairman
—Formulate responsibilities and organization of SSEB
—Establish source selection criteria
—Establishing weighting factors
—Assign cost panel
—Establish source selection schedule
—Approve plan

VIII. SUMMARY

The source selection plan, if done thoroughly and with care, will provide for a smooth, efficient source selection process. Additionally, if the contract award is challenged due to a perception that the process was unjust, this formal plan provides the government the means to refute the claim. It behooves the program manager to take the time and to assign the resources to compose a plan that establishes the background and procedures. This will allow the source selection team to carry out its task with a minimal amount of unknowns or other delay-causing events. To assist the program manager in formulating a plan, an event check list is provided at Figure 1.

FACT SHEET PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS MANAGEMENT COLLEGE

Author: DSMC, Business Management Department

Number: 3.6
Version: Update
Date: November 1988

I. TITLE

Contract Types

II. REFERENCES

—Federal Acquisition Regulation (FAR) Parts 216 and 217

—DOD FAR Sup, Parts 216 and 217

—Armed Services Pricing Manual (ASPM), 1986

—Manual for DOD/NASA Incentive Contracting Guide, Oct. 1969

III. POINTS OF CONTACT

—Local Contracting Office

IV. PURPOSE AND SCOPE

—Provide information on types of contracts used by DOD.
—Describe the principal factors to consider when selecting a specific contract type.

V. DOD POLICY

—The specific type of contract should be determined by the degree of risk in contract performance. When the risk is minimal or can be predicted with an acceptable degree of certainty, a firm fixed-price contract is preferred. However, as the uncertainties become more significant, other fixed-price or cost-type contracts should be employed to accommodate these uncertainties and to avoid placing too great a cost risk on the contractor.

FAR POLICY

—Contracts resulting from sealed bidding shall be firm fixed price or fixed-price with economic price adjustment.
—Contracts as a result of negotiation may be of any type or combination of types that will promote the government's interest.
—The cost-plus-a-percentage-of-cost-type contract shall not be used.

VI. CONTRACT FORMS AND TYPES

The basic contract forms are completion, or term ("level of effort").

The basic contract type categories are cost-reimbursement, or fixed-price. Each of the two contract categories is further divided into a number of specific contract types.

—The Basic Contract Forms

1. *Completion Form* contracts (either cost-reimbursement or fixed-price) are used when the contractor is required and guarantees to deliver a specified, definitive end-product described in the contract. The contract is completed upon delivery and acceptance of the specified end-product by the government. Under a cost-reimbursement contract, if the specified work is not completed by the contractor within the original contract price, the contractor is obligated to complete the work only if the government funds the additional effort; under a fixed-price contract, the contractor is obligated to complete the work at its own expense.

2. *Term Form* contracts (restricted to cost-plus-fixed-fee, award-fee, and firm fixed-price types) are often used for early research and development (R&D) efforts where technical outcomes are difficult to predict and assurance of technical success is lacking. The term contract provides that the specified deliverable end-product, constituting the scope of the contract, shall be determined by labor days (or months or years) of effort over a designated period of time using personnel and facilities as specified contractually.

—Basic Contract Type Categories

1. *Cost-Reimbursement Contracts.* The government is required to reimburse the contractor for all allowable, allocable costs reasonably incurred in contract performance up to the amount originally estimated for contract performance. Once the funds run out, the contractor may stop work until the contracting officer (CO) authorizes additional funding. Since the original contract price was predicated on an estimate, the CO can provide additional funding without receiving new consideration from the contractor. Thus, the cost-reimbursement type contract allows the government considerable flexibility (at additional cost) in redirecting the contractor's efforts within the scope of the contract in response to changes in technology or mission requirements.

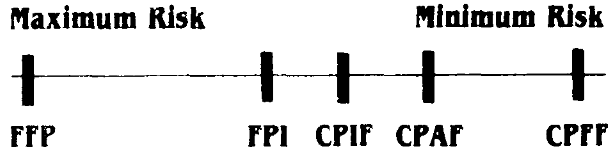
2. *Fixed-Price Contracts.* The major difference between fixed-price and cost-reimbursement contracts is that with fixed-price contracts, funding of cost overruns beyond a firm fixed-price (or ceiling price) is legally impossible. The contractor is obligated to deliver a specified end-product at the contractual price, regardless of the actual cost. If the contractor's actual costs are lower than the estimates used to establish the agreed-on price, the contractor makes more profit. Fixed-price completion contracts should be used only for procurements that do not involve substantial uncertainties in cost, end-product performance, or schedule outcomes.

—Spectrum of Contract Types Based on Cost Risk

1. *General.* The two categories of contracts, cost-reimbursement and fixed-price, fall along a spectrum reflecting the varying cost risk borne by the contractor and the government. At one end of the spectrum is the firm fixed-price contract where the contractor bears the maximum cost risk. At the other end of the spectrum is the cost plus-fixed-fee contract where the fee, rather than price, is fixed, and the government pays all of the contractor's actual costs which are allocable and allowable. Here the contractor bears the minimum cost risk. Between these extremes are varying contract types with differing degrees of contractor cost risk, depending on the degree of technical, cost or schedule uncertainty involved in the contract performance.

The major contract types to be discussed are arrayed across the risk spectrum below.

COST RISK TO CONTRACTOR



2. *Firm Fixed-Price (FFP) Contracts.* The FFP type contract provides for a price that is not subject to any adjustment by reason of the contractor's cost experience during contract performance. This arrangement places the maximum cost risk on the contractor. Since the total contract price is fixed, the contractor must manage costs within that price in order to realize a desired profit. As the contract price is made up of cost plus profit, the greater the cost, the lower the profit; thus, the contractor has the maximum incentive to achieve lower cost to gain higher profits.

The FFP contract is most appropriate when reasonably definitive design or performance specifications are available, such as, for the purchase of standard or modified commercial items or standardized military items. The government's ability to obtain an FFP contract is directly related to the contractor's ability to objectively estimate anticipated costs. If the uncertainties of contract performance can be identified and their impact on costs reasonably estimated, the contractor will be more willing to accept a contract on an FFP basis.

Most FFP contracts are of the completion form. There, is, however, a term form of the FFP known as the fixed-price level of effort (FP-LOE). This contract type is appropriate for short-term R&D efforts where the scope of the effort, in terms of types and quantity of labor effort and the time span, can be reasonably estimated with confidence. The contractor is required to devote a specific level of effort over a stated period of time for a fixed dollar amount. Payment is based on effort expended rather than on results obtained.

3. *Fixed-Price Incentive (FPI) Contracts.* The FPI contract provides for the negotiation of a target cost and a target profit. A ceiling price and a formula for sharing the risks of cost outcomes above or below target cost are also negotiated. The target profit is increased by the formula if final costs are less than target cost and decreased if final costs exceed the target cost. The government will not pay more than the ceiling price.

An FPI contract is appropriate when technical and cost uncertainties are too great to use an FFP contract, but they can be identified and quantified to the extent that a reasonable target can be established and a ceiling price applied with confidence that it will not be breached.

The FPI is a completion form contract, and the contractor is required to perform regardless of the final cost outcome. Thus, the contractor must perform at its own expense when the costs exceed the ceiling price. A cost-reimbursement type contract generally should be used if the ceiling price is likely to be breached.

There are two types of FPI contracts, the fixed price incentive-firm target (FPI-F), and the fixed-price incentive-successive target (FPI-S).

4. *Cost-Plus-Incentive-Fee (CPIF) Contracts.* The CPIF contract provides for the negotiation of a target cost and a target fee. A maximum fee (subject to the same regulatory limitations as the fixed fee in the cost-plus-fixed-fee contract) and a minimum fee are also negotiated together with a formula for sharing the risks of cost outcomes above or below target cost. Regardless of the final cost outcome, the fee paid may neither exceed the maximum fee nor be less than the minimum fee.

The CPIF contract is appropriate when the contract uncertainties are primarily technical which can, to some degree, be identified and quantified. The CPIF is used in preference to the CPFF when overall uncertainties preclude the use of a fixed-price type contract yet are not as undefinable as to require the use of a CPFF. The CPIF contract is most appropriate in R&D efforts where the technical uncertainties are resolvable, but the cost of such resolution is uncertain. If the overall uncertainty is primarily cost oriented, rather than technical, a CPFF might be more appropriate.

5. *Cost-Plus-Award-Fee (CPAF) Contracts.* The CPAF contract is a cost reimbursement contract that provides for a fee consisting of a base fee and an award amount that the contractor may earn during contract performance. The total fee is limited by regulation to the same thresholds as in the CPFF. It is broken-down into a base fee, which is a fixed fee (as in the CPFF), and an award fee, which is paid based on the government's unilateral judgmental evaluation of the contractor's performance and is not subject to dispute.

CPAF contracts are appropriate where specific quantitative objectives for cost, schedule, or performance cannot be defined adequately for the use of a CPIF or FPI type contract but where an incentive based on judgmental evaluation criteria is felt to be of benefit to the government. Such contracts (either term or completion) have been widely used to procure technical, administrative, and housekeeping services as well as for R&D efforts where technical uncertainties did not permit the predetermined structuring of a CPIF type contract.

6. *Cost-Plus-Fixed-Fee (CPFF) Contracts.* The CPFF contract provides for the payment, by the government, of all reasonably incurred allowable and allocable costs of contract performance plus a fixed dollar amount as a fee. The contract is negotiated and funded on the basis of an estimated cost plus a fixed dollar amount for fee. The fee is based on the estimated cost and does not vary with the contractor's actual cost experience on the contract. By statute, the fixed fee amount may not exceed 15 percent of the estimated costs for an R&D effort, 10 percent of the estimated cost for supplies or services, or 6 percent of the estimated costs for an architectural/engineering effort.

The CPFF is most appropriate when estimates of cost, performance, and schedule involve large technical uncertainties and when both the contractor and the government desire to retain as much flexibility and opportunity for change as possible. The key to the use of the CPFF is cost uncertainty (whether technological problems exist or not). The CPFF type contract requires a high degree of technical monitoring and redirection since it guarantees reimbursement of all of the contractor's costs which are allowable and allocable.

Since this contract type guarantees the contractor's recovery of costs, it provides the least incentive to the contractor to control costs and operate in an efficient and economical manner.

On the positive side, there is an incentive to underrun in order to make the fixed fee a higher percentage of actual costs than of the estimated costs (the statutory limitations apply only to the original estimated costs), and there is the desire on the part of the contractor to establish a reputation for cost effectiveness, or at least to avoid the reputation of chronic cost overruns.

On the negative side, there is also the incentive to deliver a technically excellent product, usually at the expense of cost. This incentive is often shared

by the government technical personnel whose reputations and promotion potential may depend more on technical excellence than cost reduction.

The CPFF contracts may be completion or term. Under the completion form, the contractor is given a clearly defined task with a definite goal and a specific end-product as a deliverable. The contractor must apply its best efforts within the funds provided to deliver the required end-product. If the effort cannot be completed within the original cost estimate, the contractor is required to notify the CO and is not required to continue performance until additional funds are provided. Any costs incurred over the amount funded are at the contractor's own risk.

Under the term form, the contractor must devote a specified level of effort over a specified period of time. The fixed fee is payable at the end of the specified period based on the contractor's certification that the contractor has exerted the specified level of effort and a determination by the CO that performance was satisfactory. Unsatisfactory performance would result in a reduction in fee, but the contractor would still be entitled to reimbursement of costs.

Figure 1. SYSTEM LIFE CYCLE

CONCEPT FORMULATION	DEMONSTRATION & VALIDATION	FULL-SCALE DEVELOPMENT	PRODUCTION	OPERATION & MAINTENANCE
MIN o······· **System Specification Definitiveness** ······· o MAX				
	Expressed in terms of:			
mission needs and not explicit system characteristics	system parameters & system segments/major subsystem interface constraints	major subsystems/critical components parameters and interface constraints	product baseline	functions to be performed
MIN o·········· **Contractor Willingness to Assume Cost Risk** ·········· o MAX				
MAX o·········· **Government Assumption of Cost Risk** ·········· o MIN				
o·········· **Most Commonly Used Contract Types** ·········· o				
CPAF CPIF FFP (LOE) CPFF	CPAF CPIF FPI	CPIF FPI CPAF	FFP FPI	FFP FPI CPIF CPAF
o ···· **When Competitive Parallel Contracts Are Used** ···· o				
FFP (LOE) CPFF (with funding ceiling) FFP	CPFF (with funding ceiling) CPAF (with funding ceiling) FPI	FPI CPAF (with funding ceiling)		

VII. SPECTRUM OF CONTRACT TYPES USED THROUGH THE SYSTEM LIFE CYCLE AND R&D PHASES

The entire spectrum of contract types available for use throughout the system life cycle and R&D stages are depicted in Figures 1 and 2. They correlate the definitiveness of work specifications and cost risk with the preferred contract type.

The rationale for using incentive contracts in the system life cycle is the following: as one proceeds through the system life cycle, the specifications for the system and equipment being developed and produced can become more detailed due to diminishing technical uncertainty. And, as these specifications become more definitive, the cost estimates for performing the remaining cycle stages become more certain. Accompanying this increase in cost certainty should be an increase in contractor willingness to assume cost risk.

At the follow-on production end of the spectrum, there is relatively little technical risk, relatively high cost certainty, and, therefore, greater contractor willingness to assume cost risk. Accordingly, high cost-risk types of contracts (FPI and FFP) are appropriate in the later stages of the life cycle.

This rationale can be restated from a slightly different perspective for R&D. At the research stage, successful technical achievement for desired results and/or performance is highly uncertain with commensurately low cost certainty. Therefore, there is low contractor willingness to assume the risk of large probable overruns. Accordingly, it is proper to use a low cost-risk type of contract (CPFF and CPIF) in the earlier stages of R&D and higher cost risk contracts as the work progresses into engineering development.

VIII. OTHER TYPES OF CONTRACTS

—Indefinite Delivery. Indefinite delivery contracts are generally used for commercial items when the exact times and/or quantities of future deliveries are unknown.

1. *Definite-quantity contracts* provide for delivery of a definite quantity of specific supplies or services for a fixed period, with deliveries to be scheduled at designated locations upon order.

2. *Requirements contracts* provide for filling all actual purchase requirements of designated government activities for specific supplies or services during a specified contract period, with deliveries to be scheduled by placing orders with the contractor. This type is used when the government anticipates recurring requirements but cannot predetermine the precise quantities of supplies or services that will be needed during a definite period. Funds are obligated by each delivery order, not by the contract itself.

3. *Indefinite-quantity contracts* provide for an indefinite quantity, within stated limits, of specific supplies or services to be provided during a fixed period, with deliveries to be scheduled by placing orders with the contractor. Usually, the contract contains minimum and maximum quantities the government shall order and the contractor shall provide.

Figure 2. RESEARCH AND DEVELOPMENT STAGES

BASIC RESEARCH	APPLIED RESEARCH EXPLORATORY DEVELOPMENT	ADVANCED DEVELOPMENT	ENGINEERING DEVELOPMENT
LOW o	Contractor Willingness to Assume Cost Risk		o HIGHER
HIGH o	Government Assumption of Cost Risk		o LOWER
o	Most Commonly Used Contract Types		o
FFP (LOE) CPAF CPFF	FFP (LOE) CPIF CPAF CPFF	CPAF CPIF FFP (LOE) CPFF	CP[illegible] FPI CPAF

4. *Ordering*. Specified government activities which can place orders against an indefinite delivery type contract will appear in the contract. Orders shall contain specifics of description, quantity, price, place of delivery, etc.

—**Time-and-Materials Contracts**. A time-and-materials contract provides for acquiring supplies or services on the basis of direct labor hours at specified fixed loaded hourly rates, including profit and materials at cost. This type contract may be used only when extent, duration, and costs cannot be reasonably estimated. The contract must include a ceiling price which the contractor exceeds at its own risk.

—**Labor-Hour Contracts**. A labor-hour contract is a variation of a time-and-materials contract, differing only in that materials are not supplied by the contractor.

—**Letter Contracts**. A letter contract is a written preliminary contractual document that authorizes the contractor to begin immediately manufacturing supplies or performing services. It may be used when the contractor must be given a binding commitment so that work can start immediately and only after the head of the contracting activity, or the designee, executes a determination and findings that no other contract is suitable.

—**Agreements**

1. *Blanket Purchase Agreements*. A blanket purchase agreement (BPA) is a simplified method of filling anticipated repetitive needs for supplies or services by establishing "charge accounts" with qualified sources of supply. They are designed to reduce administrative costs in accomplishing small purchases (less than $25,000) by eliminating the need for issuing individual purchase documents. This method is applicable to the purchase of commercial, off-the-shelf items.

2. *Basic Agreements*. A basic agreement is a written instrument of understanding, negotiated between an agency or contracting activity and a contractor, that contains contract clauses which will apply to future contracts during its term and contemplates separate future contracts that will incorporate the required and applicable clauses of the basic agreement. A basic agreement is not a contract, does not obligate funds, does not bind the government to place orders, and cannot be used to restrict competition.

It should be used when a substantial number of separate contracts may be awarded to a contractor during a particular period and significant recurring negotiating problems have been experienced with the contractor. Basic agreements may be used with negotiated fixed-price or cost-reimbursement contracts, can be discontinued upon a 30-day notice by either party, shall be reviewed annually, and can be used by government agencies other than the issuing agency.

3. *Basic Ordering Agreement*. A basic ordering agreement (BOA) is a written instrument of understanding, negotiated between the government and a contractor that contains terms and clauses applying to future contracts (or orders) during the term, a description, as specific as possible, of supplies or services to be provided, and methods for pricing, issuing, and delivering future orders under the BOA. A BOA also is not a contract and shall not state or imply any agreement by the government to place future contracts or orders with the contractor or be used in any manner to restrict competition.

A BOA may be used to expedite contracting for uncertain requirements for supplies or services when specific items, quantities and prices are not known at the time the agreement is executed, but a substantial number of requirements for the type of supplies or services covered by the agreement are anticipated to be purchased from the contractor. A CO representing any government agency listed in the BOA may issue orders for required supplies or services covered by that agreement.

—**Multiyear Contracting**. Multiyear contracting means contracting for more than the current year requirement, even though the total funding required is not available at contract award. It is a special contracting method used to acquire known requirements usually for no more than 5 years. It may be used in sealed bidding or negotiated acquisitions, resulting in firm fixed price, fixed price with economic price adjustment, or fixed-price incentive contracts. If the contract is cancelled, the contractor is entitled to recoup unamortized start-up costs.

IX. FACTORS IN SELECTING CONTRACT TYPE

There are many factors that one should consider in selecting and negotiating contract type. They include the following:

—**Price Competition**. Normally, effective price competition results in realistic pricing, and a fixed-price contract is ordinarily in the government's interest.

—**Price Analysis**. The degree to which price analysis can provide a realistic pricing standard should be carefully considered, even when there may not be full and free competition.

—**Cost Analysis**. If effective price competition and price analysis are not sufficient, the cost estimates of the offeror and the government provide the bases for negotiating contract price. Uncertainties involved in performance and their possible impact upon costs must be identified and evaluated, so that a contract type that places a reasonable degree of cost responsibility upon the contractor may be negotiated.

—**Type and Complexity of the Requirement**. Complex requirements usually result in greater risk assumption by the government. This is especially true for complex R&D contracts, when performance uncertainties or the likelihood of changes makes it difficult to estimate performance costs in advance. As a requirement recurs or as quantity production begins, the cost risk should shift to the contractor, and a fixed-price contract should be considered.

—**Urgency of the Requirement**. The government may assume a greater proportion of risk or offer incentives to ensure timely contract performance.

—**Period of Performance or Length of Production Run**. Contracts extending over a relatively long period may require economic price adjustment terms.

—**Contractor's Technical Capability and Financial Responsibility.**

—**Adequacy of the Contractor's Accounting System**. For other than FFP contracts, the contractor's accounting system must provide timely development of all necessary cost data in the form required by the government.

—**Concurrent Contracts**. If performance under the proposed contract involves concurrent operations under other contracts, the impact of those contracts, including their pricing arrangements, should be considered.

—**Extent and Nature of Proposed Subcontracting**. If the contractor proposes extensive subcontracting, a contract type reflecting the actual risks to the prime contractor should be selected.

—**Stability of Design**. Stability of design can influence other considerations, such as adequacy and firmness of specifications, availability of relevant historical pricing data, prior production experience, and adequacy of the contractor's estimating system.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Business Management Department

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I. TITLE

Incentive Contracting

II. REFERENCES

—Federal Acquisition Regulation (FAR), Part 16. 1989

—DOD FAR Sup, Part 16, 1984

—Manual for Contract Pricing (ASPM #1), 1975. (Being revised)

—DOD/NASA Incentive Contracting Guide, Oct 1969

III. POINTS OF CONTACT

—Local Contracting Officer

IV. PURPOSE AND SCOPE

—Provide information on incentive type contracts.

V. DOD POLICY

—Increases in profits or fees resulting from predetermined formula-type incentive provisions are authorized only because cost, performance or other contractual target or standards have been surpassed.

—Contracts with performance incentives are suitable for use in procurements where it is desired to provide the contractor with an incentive in the form of financial reward for surpassing the stated performance targets, and a penalty, if appropriate, in the form of decreased profit or fee for failure to achieve such targets.

—Cost plus award fee (CPAF) contracts are suitable for level of effort contracts for performance of services where mission feasibility is established but measurement must be subjective.

—Award fee provisions may be included in any type of contract: e.g., a CPIF/AF or FPIF/AF is permissable.

VI. FAR POLICY

—Incentive contracts are appropriate when a firm-fixed-price contract is not appropriate and the required services or supplies can be acquired at lower costs and, in certain instances with improved delivery or technical performance, by relating the amount of profit or fee payable under the contract to the contractor's performance.

—Fixed price incentives are preferred when contract costs and performance requirements are reasonably certain.

—The CPAF contract is suitable for use when the likelihood of meeting acquisition objectives will be enhanced by using a contract type that effectively motivates the contractor toward exceptional performance and provides the government with flexibility to evaluate both performance and conditions under which it was achieved.

VII. GENERAL

The two basic categories of incentive contracts are fixed-price incentive and cost plus incentive. Using both basic contract categories, the contracting officer issues either a contract with an incentive on cost only or a contract with incentives on cost and performance parameters, also called a multiple incentive contract. A cost only incentive contract can be fixed price incentive (FPI) or cost plus incentive fee (CPIF). A multiple or performance incentive contract can also be either FPI or CPIF. Cost only and multiple incentive contracts are predetermined formula type contracts. During

negotiation, an agreement is reached by the government and contractor specifying the exact percentage or "share" of any underrun or overrun from target that the contractor will receive or pay in the form of increased or decreased profit or fee.

An award fee contract differs from a predetermined, formula type contract, which is an objective determination of the contractor's reward or penalty based on measurable performance, in that an award fee is judgmentally and unilaterally determined by the government on subjective areas of performance, and is not subject to the Disputes clause.

Incentive contracts assume the contractor will be motivated by the opportunity for increased profit or fee on this contract. The government must recognize that external considerations of the company such as market share, technology spin-offs overhead coverage, growth, full employment, booked sales, or corporate image may impact and influence contractor motivation more than the incentive arrangement on one contract.

VIII. PREDETERMINED, FORMULA TYPE CONTACTS

—Fixed Price Incentive, Cost Only

1. FPI contracts resemble FFP contracts in that the contractor is obligated to perform for a specified price. In an FFP contract this price is stated; in an FPI it is determined by a predetermined formula, after all of the costs have been incurred. The FPI contract provides for an initially negotiated profit to be adjusted later by a formula based on the relationship of actual negotiated cost to target cost.

2. The following elements of an FPI are negotiated together as part of the complete incentive formula between the government and contractor.

Target Cost—Target Cost should represent the best mutually negotiated estimate of what cost will actually be. Target cost against which the costs of performance incurred by the contractor will be measured to determine if a reward has been earned (contractor incurred costs below target cost - an underrun) or if the contract calls for a penalty (contractor incurred costs above the target cost - an overrun).

Target Profit—Negotiated profit against which the performance rewards or penalties are applied. DOD uses the weighted guidelines profit objective (DD 1547) to establish a prenegotiation target profit. The negotiated target profit is adjusted by the formula negotiated between the government and contractor to determine final profit payable to the contractor based upon the final cost outcome.

Share Ratio—Also known as share line, sharing arrangement, or sharing formula; negotiated agreement to "share" any dollar differences between target and the final cost outcome. It is expressed as a ratio of percentage share equalling one hundred percent with the government share stated first. For example, in a 70/30 share ratio, 30¢ of every dollar difference between target and final outcome is the contractor's responsibility, either as an addition to or reduction from target profit.

Ceiling Price—Highest amount that the government is required to pay under the contract. It overrides the sharing arrangement such that regardless of the provision that the government is to share in overruns, the government will not pay more than the ceiling.

Note that the terms overrun and underrun apply to overrunning or underrunning the negotiated target cost, not the ceiling price; at ceiling price the FPI becomes an FFP type contract.

3. Other terms used in FPI contracting.

Point of Total Assumption (PTA)—Cost point at which the government ceases to share in cost overruns (e.g., 0/100). It is usually below ceiling and is often the pessimistic cost estimate used in structuring the contract. Additionally, once the contract has been structured, PTA can be determined using this formula:

$$PTA = \frac{\text{Ceiling Price} - \text{Target Price}}{\text{Government Share}} + \text{Target Cost}$$

Target Price—The sum of the target cost and target profit.

This type of incentive contract is called a predetermined formula type incentive as opposed to an award fee which is a judgmental subjective type incentive. The formula negotiated by the government and the contractor and included in the contract is therefore predetermined before contract performance is started. The formula is used

at the completion of the contract to determine the final cost to the government and the final profit paid to the contractor.

4. A simple way to structure an FPI, cost-only incentive contract:

Step 1: Estimate optimistic, pessimistic and target costs. Optimistic and pessimistic cost estimates define the range of *probable* cost outcomes, assuming sound management and aggressive cost control by the contractor. Pessimistic cost is usually the PTA.

Step 2: Establish an acceptable profit for each level of cost. Use the weighted guidelines profit objective to establish a prenegotiation target profit. Pessimistic cost plus its associated profit equals ceiling price.

Step 3: Compute the share ratio for overruns and underruns using the following formula:

$$\text{Contractor Share (CS)} = \frac{\text{Change in Profit}}{\text{Change in Cost}} \text{ or } \frac{\text{Profit}}{\text{Cost}}$$

Profit is the difference between target profit and optimistic profit or target profit and pessimistic profit.

Cost is the difference between target cost and optimistic cost or target cost and pessimistic cost.

A share ratio for an underrun is determined by dividing the difference between target cost and optimistic cost.

Step 4: Review the structure to determine if it makes sense.

Step 5: Graph it (Optional).

Step 6: Negotiate all elements of the incentive formula as a complete package.

—Cost-Plus-Incentive-Fee, Cost-Only

1. A cost-plus-incentive-fee (CPIF) contract is a cost reimbursement contract that provides for an initially negotiated target fee to be adjusted later by a formula based on the relationship of total allowable costs to total *target* costs. It should be used when the uncertainties of contract performance and the related cost of performance cannot be estimated with sufficient range of probable cost outcomes to permit the use of any fixed price contract, and when an appropriate positive fee incentive is likely to provide significantly more motivation for cost effectiveness than is found in a CPFF contract.

2. The following fee limitations, statutorily applied to CPFF contracts, are applied administratively to CPIF contracts as well.

R&D Contracts—max fee may be no greater than 15% of target cost.

Production Contracts—max fee may be no greater than 10% of target cost.

3. Elements of CPIF contracts:

Target Cost—Same as for FPI contracts.

Target Fee—Same as for target profit under FPI contracts.

Share Ratio—Same as for FPI contracts.

Minimum Fee—That fee the contractor will be paid once costs reach the pessimistic cost point. Beyond the pessimistic cost point, the contractor will still be paid the minimum fee; at minimum fee the CPIF becomes a CPFF type contract.

Maximum Fee—That fee the contractor will be paid if costs reach or go below the optimistic cost point. As with *minimum fee*, the *maximum fee* does not vary once attained.

4. Other terminology associated with CPIF contracts:

Range of Incentive Effectiveness (RIE)—An evaluation of what contract costs are likely to be. The optimistic and pessimistic cost estimates bound the RIE.

Fee Swing—Difference between maximum fee and target fee or minimum fee and target fee. It is also referred to as "fee."

Fee Pool—The total of fee swing; the range from minimum fee to maximum fee.

5. A simple way to structure a CPIF, cost only incentive contract: (Similar to FPI structuring).

Step 1: Estimate optimistic, pessimistic and target costs. This determines the RIE.

Step 2: Establish an acceptable fee for each level of cost. Use the weighted guidelines to establish a prenegotiation target fee. Do not exceed max fee limitations without appropriate approval.

Step 3: Compute share ratio.

$$CS = \frac{\text{fee}}{\text{cost}}$$

Step 4: Review the structure.

Step 5: Graph it (Optional).

Step 6: Negotiate all elements of the incentive formula as a complete package.

—Multiple Incentives

1. Multiple incentive contracting combines the motivation for technological progress, timely delivery, and effective cost control with the ultimate objective of attaining an appropriate balance between performance, schedule, and cost control—not necessarily the lowest cost. Obviously, in cost only incentives, the emphasis is on the attainment of the stated performance achievement level at the lowest cost.

Multiple incentives should be negotiated within a structure which gives appropriate weight to basic procurement objectives. This includes a balancing of the range of cost and performance goals. The proper balancing of objectives achieves two important results. First, it communicates the government's objectives to the contractor; second, and of greater significance, *it establishes the contractor's profit or fee in direct relationship to the value of the combined level of performance in all areas.* It should be assumed that the contractor will be concerned with tradeoffs between cost and performance during the execution of the contract, and, therefore, the multiple incentive structure should guide the contractor in revising its plans as expectations change. In the absence of a clear communication of the desired government objectives, this is impossible. The contractor's program management procedures must provide visibility for tradeoffs. Further, the time for the government to establish the desirable tradeoffs is prior to the award of a contract or definitization of a change order.

Incentivized parameters may be system characteristics such as range, speed, reliability, maintainability, thrust and survivability or schedule delivery dates, etc. Optimistic schedule and performance should not be easy for the contractor to accomplish nor impossible to achieve; they should be achievable and of value to the government.

Also the pessimistic performance and schedule parameters must be acceptable; use only those that are acceptable to the government.

2. If the contract is a CPIF multiple contract, fee limitations apply.

3. Elements of multiple incentive contracts.

FPI — same as for FPI cost only

CPIF — same as for CPIF cost only

In addition to the elements discussed previously, the contract will include the performance and schedule parameters to be incentivized. It is best to keep the number of incentivized parameters to a minimum, perhaps only 2 or 3. Incentivizing too many parameters dilutes the fee pool, resulting in a lack of true motivation for the contractor.

Cost is always an incentivized parameter in a multiple incentive contract.

4. Structuring a multiple incentive contract is a rather complex undertaking which is beyond the scope of this Fact Sheet. Refer to the Manual for Contract Pricing (ASPM #1) or the DOD/NASA Incentive Contracting Guide.

The structuring of a multiple incentive contract, in essence, answers the following three questions:

a. What parameters shall be incentivized?

b. What is the minimum acceptable value and the highest desired value (GOAL) for each parameter?

c. How much money is available to use as incentive?

d. Of that money available, how should it be distributed among the selected incentivized parameters?

IX. AWARD FEE INCENTIVE CONTRACT

The DOD FAR Sup states that the "award amount" of the cost plus award fee (CPAF) contract may be used in conjunction with other types and kinds of contracts for the government's benefit. While recognizing that an award fee can be used in other contract types, the following discussion centers on a CPAF type contract since the FAR describes the CPAF more fully.

1. The CPAF co[illegible]ct is a cost reimbursement type providin[illegible]se (minimum) fee, and for an additional fee amount that may be awarded, in whole or in part, based upon periodic evaluations of ongoing contractor performance. A CPAF arrangement does not include predetermined targets and automatic fee adjustment formulas; instead, the award fee determination is a judgmental one, made unilaterally by the government.

The CPAF contract is unique in providing not only profit (fee) motivation but also the considerable motivation resulting from periodic evaluations by the government. In addition, it offers significant evaluation flexibility in two forms:

(i) the flexibility to evaluate on a judgmental basis, taking into consideration both contractor performance levels and the conditions under which such levels were achieved; and

(ii) the flexibility to adjust evaluation criteria from evaluation period to evaluation period, to reflect changes in government management emphasis or concern.

2. Elements

CPAF contracts include an estimated cost, base fee, an award fee, a maximum fee (the sum of the base and award fee amounts), and a fee payment plan. The contract also includes a provision specifying that award fee determinations will be made unilaterally by the designated Fee Determination Official, in accordance with an approved evaluation plan, and that such determinations will *not* be subject to appeal under the Disputes clause of the contract. The performance evaluation plan normally is not included in the contract, thus preserving the government's right to alter the plan unilaterally to reflect any changes occurring in management emphasis or concern.

The estimated cost is the same as target cost discussed earlier. The fee limitations applied to CPIF contracts also apply to CPAF contracts. The DOD FAR sup precludes the use of weighted guidelines for determining a fee objective. Also, the DOD FAR Sup limits the base fee to a maximum of 3% of estimated costs. The base fee may even be zero.

The fee payment plan discusses the evaluation periods and interim payout periods based on those periodic evaluations.

An Evaluation Plan is also developed by the government prior to the evaluation period it will cover. It should be tailored to motivate the contractor to make the best possible uses of the company's resources to improve performance. It also should provide for an equitable and timely evaluation process. In addition to being fair, the plan should communicate plans and procedures and anticipate the establishment of effective communications between the government monitors and the contractor.

Award fee contracting is advantageous because of its emphasis on communication between the parties and the flexibility afforded the government to change emphasis during contract performance. CPAF contracts may be attractive to industry because they allow the contractor to earn a higher fee (for outstanding performance) than would be possible under a CPFF contract.

CPAF contracting assumes an ability to evaluate performance and determine, on a judgmental basis, whether and to what extent such performance merits an award fee amount over and above the base fee established. The award fee potential should be of sufficient amount to reward the contractor through all levels of performance in excess of minimum acceptable. Award fee adjustments represent increases from base fee and depending upon actual performance as evaluated in accordance with the evaluation plan, the contractor may earn all, part or none of the award fee amount available.

4. Structure

The award fee requires a formalized government evaluation structure for administration. The Fee Determining Official (FDO) makes the final decision as to the award fee to be paid to the contractor based on input from the contractor and the government's Performance Evaluation Board (PEB).

The PEB is established by the FDO and is responsible for the development of the award fee evaluation plan, ongoing evaluation of contractor performance, and submission of a report to the FDO.

Performance Monitors, designated by the Chair of the PEB, are responsible for monitoring, evaluating and assessing contractor performance in their assigned areas; periodically preparing a performance monitor report for the PEB and recommending any needed changes in the evaluation plan.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

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I. TITLE

Negotiation Process

II. REFERENCES

—Federal Acquisition Regulation (FAR) Subpart 15.8, "Price Negotiations"

—DOD FAR Supplement Subpart 215.8, "Price Negotiations"

—"Defense Contract Negotiation Workshop," Headquarters, Naval Material Command, Washington, D.C., October 1981

—"The Negotiating Game," C.L. Karrass; Nelson, Foster & Scott Ltd.; 1970

—"The Art of Negotiation," G.W. Rull, 1962

—DSMC Fact Sheet Number 3.9, "Negotiation Techniques"

III. POINTS OF CONTACT

Local contracting office

IV. PURPOSE AND SCOPE

To describe the process of contract negotiations starting with the issuance of a solicitation through signing by bilateral contract for acquisition of supplies and/or services.

V. DEFINITIONS

—Negotiations means to communicate or confer with another in order to come to terms or reach an agreement on some matter of mutual concern.

—Price means cost, plus any fee or profit applicable to the contract type.

—Successful negotiation is the achievement of a mutual agreement in the best interests of both parties.

VI. DOD POLICY

Contracting officers shall purchase supplies and services from responsible sources at fair and reasonable prices. The objective is to negotiate a contract of a type, and with a price, providing the contractor the greatest incentive for efficient and economical performance. The negotiation of a contract type and a price are related and should be considered together with the issues of risk and uncertainty to the contractor and the government. The intent is to arrive at a common understanding and agreement on the essentials of a contract that will result in a price calculated to result in the lowest ultimate cost to the government.

VII. MAKING NEGOTIATIONS HAPPEN

Whether you are conducting a negotiation as a government negotiator or participating in the negotiation as government team member, you will find that a negotiation is a challenging process requiring knowledge, skill, and experience. You must know and understand thoroughly what you are negotiating, where you intend to go in the negotiation, and how you intend to get there. You must have an understanding of the negotiation process, and how best to work within its framework. Success can be achieved only through a commitment to include the right people, using a process that works, setting realistic expectations, and ensuring the momentum to get the job done.

—*The Right People*. Regardless of the size of the negotiation, selection of a leader and team should be a major concern. Successful negotiations are

the result of a negotiator's skill, and preparation that requires training and experience. A contracting officer is assigned as the leader of a particular negotiation. For a complex acquisition, a supporting team needs to be organized. The team members should be specialists in areas needing particular attention because of acquisition requirements. The leader is in charge of the team and makes assignments when their special services are necessary. The leader has overall responsibilities concerning the acquisition and the contract, but team members have advisory responsibilities concerning questions in their specialization.

Supporting team members may include negotiators, price analysts, administrative contracting officers, auditors, design engineers, production specialisits, quality control specialists, and legal advisors.

The team leader must know when and how to call on team members and how to use their skills to the best advantage. The leader must continually exercise the positive control necessary to ensure effective communications and present a unified position to the contractor.

With increasingly complex government acquisitions, the team approach is a necessity, but because of the complexities, the leadership role becomes an even more important aspect of the team's performance. The leader must organize the team into an integrated unit working in harmony toward well-planned objectives.

—*Preparing for Negotiation*. The rewards are found in the quality of the contract; that is, for example, when the work statement or the technical descriptions are expressed so well that during the period of contact performance there are no significant differences in interpretations. The payoff can be realized in terms of fewer change orders because technical requirements were well understood from the beginning. Thoroughness in cost estimation may prevent extreme cost overruns or underruns. Thorough preparations made by both teams are usually reflected in the quality of the contract when the negotiations are completed; and, when the contract is completed, the realized results will differ little from expectations of the planners. Figure 1 sets forth the sequences of steps involved in preparing for negotiations.

Figure 1. NEGOTIATION PREPARATION

- **Understanding the requirement**
- **Fact finding and analysis**
- **Setting prenegotiation objectives**
- **Management review**
- **Develop the negotiation tactics**

Perhaps the most important thing the government team must do in preparing for negotiation is to gain a clear *understanding of the acquisition requirements*. The requirement is, of course, the foundation of all acquisition action, and it vitally affects most steps in the acquisition process. To a greater or lesser degree, the nature of the requirement controls price, contract type and contract terms, and negotiation positions.

The first source of information for *fact finding and analysis* is the contractor's proposal, which is submitted in response to the government's solicitation. Under specific conditions, a cost breakdown must accompany the price proposal. The requirement to submit cost and pricing data by the contractor, and the requirement to submit a certificate of current cost or pricing data are covered in government regulations. These requirements are based on the statute broadly known as the "Truth in Negotiation Act."

The contracting officer requests a technical analysis, field pricing support, and price analysis of the contractor's proposal. Appropriate qualified personnel review and assess the proposed material requirements, labor hours, special tooling and facilities, and other data pertinent to the cost or price analysis. The cognizant audit activity reviews the contractor's proposal and is the only government representative authorized general access to the offeror's books and records. The conclusions of these reviews are documented in a technical evaluation, field pricing report, audit report, and price analysis to the contracting officer.

During the review and analysis process the contractor may be requested to provide additional information and data to support its proposal. Meetings may be conducted with contractor representatives to obtain additional information.

Prenegotiation Objectives are developed from an analysis of the issues and alternatives identified during the fact finding and analysis step of the preparation process. All of the prospective contract terms and conditions are potential issues for negotiations. Each issue alternative will be priced before selecting a negotiation objective for each issue. The negotiation team will develop its objective for the entire contract by accumulating the issue objectives and the agreed-upon terms and conditions in the contractor's proposal.

Another step in the planning phase is *management review* of the prenegotiation objectives developed by the team. The review procedures vary according to ground rules set by the acquisition office. The review sets the bounds within which the team can make decisions and permits acquisition management (including the program manager) to exercise its prerogative of management control.

Once the determination and priority of the overall objectives are set, the next step is to *develop the negotiation tactics* to be used to attain these objectives.

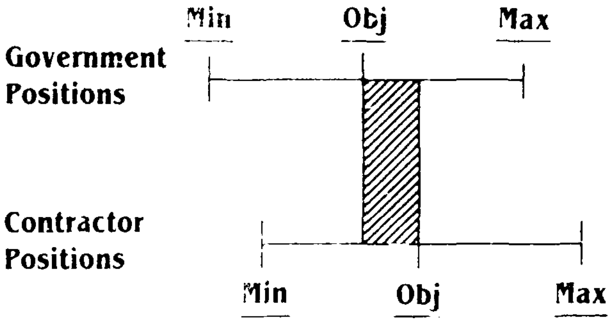
The tactics needing to be employed for negotiation require a great deal of resourcefulness on the part of the team. It calls for knowledge of what an immediate situation demands, which, in turn, requires the sizing-up of a situation in terms of what is necessary to protect an interest, or what moves are necessary to progress toward agreement. It requires a keen sense of timing.

VIII. PERFORMING THE NEGOTIATIONS

After the many hours of data collection, analysis, and the coordination with team members you have reached the critical point—the negotiation, when the two parties sit down, look at their counterparts across the table and go to work. The meeting typically consists of an opening, exploratory session, negotiation session, competitive negotiations, and concluding negotiations. During the meeting five modes of negotiation are taking place. A recognition of these modes will help make the team more comfortable, allow the team to gain more information, and avoid or break deadlocks.

—First, the cooperative mode means there is always a better deal available for both parties if they are willing to take time to look for it.

Figure 2. NEGOTIATION SITUATION



—Second, the attitudinal mode recognizes that compatible attitudes (trust, integrity, credibility, etc.) lead to better agreements with a commitment to mutual satisfaction.

—Third, the personal mode requires satisfying personal issues that neither party can demand out loud, but without which no deal can be made.

—Lastly, the competitive mode is when the different prospectives of a buyer and seller must be resolved.

Opening the Conference. The opening of the conference is critical. Here the stage is set. The manner of the opening can influence attitudes that will prevail throughout the conference and can either aid or prevent reaching agreement.

It is the responsibility of the team leader to open the conference with a statement that not only outlines the area for discussion but sets forth the meeting format. The opening statement actually consists of a presentation of background information in which the leader defines the problem or nature of the acquisition action in order to develop understanding, interest, and a supportive climate. This opening statement should be clear, complete, and carefully planned since either consciously or unconsciously, it helps determine whether the meeting will be orderly and productive, or confused and misguided.

Exploratory Session. A negotiation team's price objectives, its diagnosis of the issues, and the positions it take before the negotiation session are based upon preliminary information obtained from the contractor's proposal, or from various other sources. Such positions or objectives cannot be firm

until an opportunity has been provided to question the contractor concerning various aspects of the proposal or other relevant facts. The questioning may reveal differences of interpretation of the information, or it may reveal problem areas that need clarification. The government team should plan its questions and discussion on the basis of meeting this test. Important areas where questioning could be necessary would be that of discovering the basis of assumptions made for the projections of direct manufacturing and engineering labor hours and rates and material.

The exploratory session should not close until government negotiators have accomplished their purpose; that is, (1) have tested the realism of the issues and positions as planned in the prenegotiation planning period, (2) have determined, by the many questions asked, the basis for the contractor's position, and (3) have determined the contractor's probable stand to be taken on issues and the relative importance they are likely to place on each. When these purposes have been accomplished, a recess should be called to reassess positions, issues, and objectives. The exploratory session has offered the government team the advantage of testing ground before the actual negotiation, thus it can enter with a higher degree of confidence.

Negotiation Session. When both sides have done a thorough job of preparation, it is easy to say that the negotiation is simply that of carrying out the prearranged plans. However, this is altogether too mechanical and too simple. What makes it much more complex is the fact that the whole process of reaching agreement involves human beings, and their basic interests are opposed. The negotiators are committed and are expected to be loyal to the well-being of the organization they represent.

Negotiators meet with the expectation of reaching an agreement. Therefore, the process of negotiation is to find the point where each side believes it has gained more than it has yielded in the process. This feat is possible only because different people (even opponents) value things differently. The marketplace, when it is competitive, accommodates different values in the minds of those who make transactions, and the price at which each transaction is consummated is a result of the "give and take" forces present in the market. But, when negotiation is necessary, because there is no market price, the negotiators must enact all accommodations which otherwise would have been accomplished by the market forces. Yielding, or making accommodations, are not necessarily losses to the one who makes them; rather, they are made because of an expectation of gain.

Figure 3. THE NEGOTIATION PROCESS

—Acquisition plan
—Purchase request
—Solicitation
—Proposal
—Negotiation preparation
—Performing negotiation
—Documenting negotiation
—Contract award
—Performance

The outcome of contract negotiations is the result of government and contractor interface throughout the entire process. The program manager needs to understand the process and plan for interactions that result in a contract in the best interest of both parties.

Competitive Negotiations. Objectives made by two different teams do not necessarily coincide. When both teams have conceded to the point where each has reached its objective, concessions from these points are extremely difficult. Since objectives are not announced, each team does not know when the other has reached the objective, except by guessing. The negotiation situation is shown in Figure 3.

The shaded area represents the hard core, which may be difficult to penetrate since both teams have yielded by concessions as much as they planned. Negotiations tend to become stalemated at this point. To prevent such an occurrence there are tactics the team should have considered and planned to use. It becomes paramount that negotiators have the attitude of finding a formula or solution that will serve both interests. Anyone can deadlock; the successful negotiator seeks and achieves successful *agreement*.

Concluding Negotiations. The parties must be certain that a common understanding has been reached before terminating the negotiation con-

ference. If some important conditions have been overlooked or misunderstood, the contractor may refuse to sign the contract and it may become necessary to reopen negotiations at a later date. Often, it is desirable to put essential terms of the agreement into writing before the negotiation conference ends.

IX. SUMMARY

Contract negotiations are a process that starts with the first discussion between a program office representative and a potential contractor's representative. Data collected concerning the requirement are used to develop acquisition plans and the solicitation, which, in negotiation parlance, is the government's first offer. Negotiations are formally completed when the contract is signed, but they actually extend throughout the contract performance cycle. Figure 3 is a summary of the major steps in the contract negotiation process.

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I. TITLE

Negotiation Techniques

II. REFERENCES

—"Negotiating Techniques," Gerard Nierenberg

—"The Negotiator," Royce A. Coffin

—"The Negotiating Game," Chester L. Karrass

—"You Can Negotiate Anything," Herb Cohen

—DSMC Fact Sheet Number 3.8, "Negotiation Process."

III. POINTS OF CONTACT

Policy and Organization Management Department, DSMC, (703) 664-2685/6166; AV 359-2685/6166

IV. PURPOSE AND SCOPE

This fact sheet is designed to:
—Describe basic negotiation strategies
—Describe sources of power in negotiation
—Contrast win-win versus win-lose modes of negotiation

V. NEGOTIATION TECHNIQUES

Introduction

In the program office, skill in negotiations is essential to managers of human or material resources. Negotiations are a beneficial way for professionals to coexist in the demanding world of systems acquisition. Skillful negotiators must be able to distinguish between cooperative and competitive modes of negotiation. The latter mode is more common but the cooperative mode is recognized as more appropriate for developing a non-adversarial, long-term relationship between the DOD and private industry. Determining which mode of negotiation is used by the other party is crucial to your strategy, as competitive negotiators focus on defeating their opponents and cooperative negotiators are receptive to joining forces with their opponent to defeat a mutual problem.

—Essentials of Negotiations

At least two parties must voluntarily come together, with each being at least partially dependent on one another, and each recognizing that more is to be gained by participating in give-and-take negotiations than abdicating or attempting more powerful means (coersion/persuasion). Successful negotiations require discipline, motivation, openness, planning, and some level of trust. The process gives (1) lasting agreements, (2) analysis of issues, (3) a working base for future successes, and (4) a range of options plus analysis of the best alternative.

Once into the negotiation process, both parties usually find themselves developing plans with several options or alternatives. Often, each party is forced to consider its position in the light of many different scenarios as each goes for what he/she wants. Diplomacy and creativity occur with the parties usually discovering more satisfying alternatives than his/her original positions indicated.

Preparation is a crucial step in successful negotiations. Experts state that "65 percent of outcomes are determined by preparation." The process of negotiation should begin months, maybe even years, before the scheduled bargaining event.

In preparing for any negotiation, the agenda should be broken down into three parts: before, during, and after negotiation.

Before negotiating, take these steps:

1. Identify the exact situation and relevant parties involved.
2. Analyze all parties' *real* interests, as well as the positions they are taking.
3. Scope out the meeting place. Is it cooperative or compromising? Does it fit what you need to accomplish?
4. Define the relationships of the parties. Are they adult-to-adult, buddy-to-buddy, manager as sole decision-maker, boss, or strictly an order-giver? What have past dealings been like?
5. Analyze personality makeups: Are the parties adamant? Stubborn? Cooperative? Patient?
6. Formulate issues to watch for during the process. Generate creative concessions only as you are joined by the other party in reaching win-win solutions.
7. Identify the other party's needs: What are the aspiration levels and highest goals the other party will strive for?
8. Build positive personal relations: Prompting continued service, interaction, or interdependence.

During negotiations, consider these factors:

1. Select a comfortable, calming setting. Which of these would best serve the purpose? Office? Club? Restaurant?
2. Discuss only relevant issues. Cla..., and recognize assumptions. Use your preplanned agenda of issues and classify each as it arises as a win-win, win-lose or mixed. Rank order issues. Suggest creative solutions if faced with an impasse or move on.
3. Be aware of such inhibiting factors as a disconcerting physical environment, tension, stress the need for a break. If present, change them.
4. Be sensitive to feedback generated during negotiations for vital information. Are you communicating clearly? Do the body language, voice intonations, and facial expressions indicate progress, joining or countering by other party to the issues you raise.
5. Continually assess your position vice original goals. Has the other party's strategy changed? If progress is not made, is it time to change strategies or call it a day?

After negotiations, consider these items:

1. Intensive analysis of feedback should be conducted. Ask yourself: Have the goals been achieved? Did you maintain and develop, or destroy, the relationship?
2. Were you adequately prepared? Did you formulate and stick to the agenda? Did you adequately assess the vital issues?
3. Was the negotiation cooperative or competitive in nature? Did you keep an open mind, use active listening, and build trust?
4. What mechanisms can be employed for improving the next negotiation?

Negotiating is an extremely complex and interpersonal behavior. Many variables come to play simultaneously and, in the best of things, no one negotiator will master them all effectively. All levels of negotiations reduce to interpersonal encounters. This is because the human factor is not predictable, thus negotiating is as much an art as a science. Success or failure often is determined more by idiosyncrasies, clever moves, blunders, or individual insight than all the formal elements of the transactions that regulate the event.

VI. THE SUCCESSFUL NEGOTIATOR

—Makes high initial demands (more often leads to success rather than failure or deadlock)
—Avoids making the first concession, concedes slowly, makes smaller concessions during negotiations and lower concessions as the deadline approaches
—Realizes that extremely quick settlements tend to favor skilled negotiators and result in extreme outcomes
—Improves his/her success and fails less with higher aspirations (settlement goals)
—Realizes obstinate negotiators deadlock more frequently than conciliatory persons, but fail less
—With high aspiration levels, is big winner regardless of whether he has power leverage
—Realizes that settlements most often occur shortly before deadline, and that losers make the largest concessions in a negotiation.

Basic concepts for the negotiator:

—Negotiate only with those in authority; no concessions to intermediaries

—Satisfy some needs of all parties—key to success

—Be calm, don't lose temper, be prepared to trade

—Sell yourself and don't compromise your objectives (better to deadlock than agree to unacceptable terms)

—Deal from strength, use your strong points—be confident

—Tell your story yourself—in person, best bet for getting message across

—Sleep on it—resolves doubts, which delays mistakes

—Keep a poker face—be positive, but matter-of-fact in expressions

—Don't underestimate others—they are strong enough to be facing you

—Be personal—learn names and use them

—Don't be too exclusive—allow other side to include whomever

—Be discrete—respect confidentiality

—Be reasonable, but never let your guard down (days of masterful negotiation can be neutralized by a minute of relaxation)

—Always end on a positive note.

Tactics:

—Have total plan so you can stay on course while fielding counters

—Avoid marathon sessions—tired negotiators make poor showings

—Be the aggressor—take initiative to accomplish objectives

—Caucus often—relieves tension, eliminates having to retreat on issue, invites counsel from associates

—Interruptions turn people off—privacy is best

—Silence is golden—best way to reply to a totally unacceptable offer

—Phrase your questions for positive answers, get other side in habit of saying "yes"

—The fewer the participants, the earlier the agreement

—Make all terms specific—never suggest a range of values/figures as other side will take lower value

—Make promises with caution—easy to be unable to fill them

—Each day is a new ball game so be ready for attempts to retrade

—Be the first to bring up major terms (at appropriate time)

—Look for ways to verify what you are told and evaluate statements

—Break the tension and inject humor or break if people tightening up

—Defer discussion about sensitive points—don't risk an early confrontation, just agree to as many other terms as possible

—Make agreement easy, disagree on a positive note

—Don't react too unfavorably to your own mistakes

—Don't rush the other side—causes them to look deeper

—When the mission is accomplished—leave! (Needless talk invites saying the wrong thing).

Psychology:

—Be yourself—putting on an act easily detected loses credibility

—Don't knock others—who likes to be criticized?

—Don't embarrass other people, and be positive when discussing other people

—Be cautious about expressing unrelated opinions. Bet on it! Others more often disagree than agree with you

—Beware of ignorance—if other side is uninformed about areas of their responsibility, alter plans, don't press it

—Check to see if he/she is with you—or are they preoccupied/absorbing your previous comment?

—Reconnaissance is valuable

—Reluctance means problem or weakness, absence is a red flag—note but proceed with caution

—Be sensitive to others, show interest in others

—Think before you speak and expect negative reactions

—Keep the number even—don't try to overpower other side with attendees

—Keep it simple—people won't agree to things they don't understand

—Timing is a critical factor—most people are at their best around 10:00 a.m. (which is a good time to begin negotiations).

VII. SOURCES OF POWER

Every negotiating event offers each side the opportunity to seize a power leverage over the other side. Power is being able to offer the other side "an offer they can't refuse." Skillful negotiating tips the power ratio in favor of one side and in-

volves several of the following nine sources of power to gain the upper hand and assure success:

1. Reward

Who has the most to gain? Tangible rewards include money, property, rights, privileges, expanded markets, and product control. Intangible rewards may include worth, safety, prestige self-esteem or self-actualization. The side receiving the greater reward is most likely to control this source of power and strive harder for success.

2. Punishment or Non-Reward

Who has the most to lose? Deadlock, threats, denial, strikes, tension, loss of confidence, loss of influence, etc., are factors weighing heavily and tilting the power ratio in favor of the negotiator with the most to lose. Opponents with their backs against the wall, go for broke—no-holds-barred negotiating leverage and use this source of power (the avoidance of punishment or failure) to press for their position.

3. Legitimacy

Who seems to have the "right of way?" Perception of greater authority or institutional backing by traditions, laws, regulations, or status of opponent by historical precedent cause one side to fail to question, or to reduce attacks on issues proposed by the opponent who appears to be more legitimate. Military officers, municipal officials, presidential appointees, and U.S. federal attorneys are examples of legitimacy as a power advantage against opponents.

4. Commitment

Who has the greater tenacity? Loyalty and friendship are the strongest bench marks of this power source. Employee loyalty to a company, marriage commitment, diplomatic allegiance, and POW steadfastness are all examples of power taken from personal commitment to an ideal, value, or life cause.

5. Knowledge

Who appears to be the expert? Power from control, or superiority of information is critical in negotiations. Success in negotiations is largely determined by how well homework and preparation is completed. The more one knows about opponents' objectives, the better his/her bargaining position. Knowledge of the product, marketplace, legal bounds, or the theory and practice of negotiation strategies is added power to one side's position.

6. Competition

Who has the upper hand, the buyer or seller? Power scales are tipped in favor of the buyer with multiple sources, or the seller with other work to keep his/her plant busy. Reduction of competition favors the buyer or initiator of the bargaining event.

7. Uncertainty and Courage

Who has the least fear of taking a risk? Security and avoidance of risk are common to everyone, so if one negotiator is willing to accept greater risk or uncertainty, his or her power is enhanced. Tolerance of deadlock, courage to hold ground or make concession, and forced actions are indicators/measures to which side will capture the upper hand. Working outside the human comfort zone or beyond the risk avoidance plateau adds power to that negotiator.

8. Time and Effort

Who appears to have time on his/her side by being able to use it to his/her advantage. The advantage from this power source is seen when time appears to march against an opponent. Your patience strengthens this power source by appearing as though you set your own deadline. *Remember*: Both sides have a deadline or they wouldn't be negotiating. The trick is always to have your deadline occur five minutes after that of your opponent. Energy level, zeal, hard work, and early planning are power sources that will overwhelm lazier or apathetic opponents.

9. Bargaining Skill

Who appears to be the professional? Power comes from the ability to listen, persuade, analyze, and decide on issues. Skill at making affirmative statements, asking penetrating questions, exhibiting strong body language, and controlling nervous gestures or tension are parts of this source of power. Positive and confident eye contact, together with clear and direct statements, are signs of the skilled negotiator.

VIII. MODES OF NEGOTIATION

There are no neat formulas for negotiating. More often than not, negotiations are messy affairs. But, the skilled negotiator is able to plan for predictable

events, present clear objectives, and carefully work out a strategy for executing his/her needs. The list of negotiating modes or strategies that you could face is almost endless, varying as a function of the individuals involved. This last section will cover the range of strategies by looking at the most cooperative (win-win) and most competitive styles of negotiating. It is important to remember that these two modes are the extremes along a continuum of possible negotiating strategies and are seldom found exactly as here described. Some tactics that can be applied during negotiation are presented in Appendix 1.

1. Win-Win Model

In the win-win model, the belief is that there is always a better deal for both sides. Thus, offering outcomes seen as acceptable gains for both parties is paramount for negotiating in this mode. Win-win is a strategy of resolving conflict among opponents, reaching agreement on issues important to both sides, normalizing relations, and combining efforts to solve the problem. Cooperation from the viewpoint that together we can obtain a better outcome focuses attention squarely on the problem; i.e., to build a better airplane, on schedule, at reasonable cost. Mutual trust is the identifying mark of the win-win style. The win-win style is considered the trend for the future, especially when negotiating issues among firms within the same rational boundaries.

CONCEPT: THERE'S ALWAYS A BETTER DEAL FOR BOTH SIDES

FOCUS: DEFEAT THE PROBLEM

STRATEGY: EXTREME COOPERATION

NEGOTIATE TO
A. RESOLVE CONFLICT
B. REACH AGREEMENT
C. NORMALIZE RELATIONS
D. COMBINE EFFORTS TO SOLVE PROBLEM

GOAL: OUTCOMES OFFERING ACCEPTABLE GAINS FOR ALL PARTIES

2. Win-Lose Model

The win-lose style, the most common and competitive, is known for its "hardball" tactics and its goal is "winning at all costs." Also known as the "Soviet mode," this mode of negotiating requires shrewd countering by the opposing side because power is focused on defeating the opponent rather than on the problem or subject of the negotiations.

CONCEPT: IF OTHER SIDE WINS, IT IS AT MY EXPENSE

FOCUS: DEFEAT THE OPPONENT

STRATEGY:
A. EXTREME INITIAL DEMANDS
B. EMOTIONAL TACTICS
C. LIMITED AUTHORITY OF NEGOTIATOR
D. STINGY CONCESSIONS
E. IGNORE DEADLINES

GOAL: WIN AT ALL COSTS

IX. SUMMARY

Adapting a give-and-take approach to the negotiating process provides the means of resolving most disagreements in a way that maintains effective relationships. However, the program manager must closely observe the receptivity of the other side to his cooperative overtunes and determine if mutual giving is growing between parties rather than one-sided taking. If the other side persists in a competitive mode with its win-at-all-cost philosophy, it is doubtful that you will survive as the agent of cooperation. Such circumstances may require that you stop the negotiation until you can adopt a more competitive approach.

Apendix 1. SOME MAJOR PERSUASIVE NEGOTIATING TACTICS

TACTICS:	COUNTERMEASURES
(1) APPARENT (OR THREAT OF) WITHDRAWAL implies that you might withdraw or that you are planning another move. The rationale is that you hope your adversary will not press for further concessions in the face of your apparent withdrawal. Also, reduces anger. "If you don't calm down, I will have to go elsewhere.	Ignore it/call his bluff/concede something.
(2) FAIT ACCOMPLI means presenting your adversary with a completed action, leaving him with no choice but to accept it as is or leave it. "Here's the completed contract. I've crossed out two items. Take it or leave it.	Put heavy penalties in contract/protest at high level/sue/get a big deposit/don't pay in advance without security.
(3) FALLBACK strategy requires you to retreat to a previously prepared position on a step-by-step basis. Begin with minor steps before taking larger ones. Your final fallback position (your bottom line) should be well supported to make it more credible. "You couldn't agree to $175 or to $150. My best and final price is $125. My boss won't let me go any lower.	Very rational.
(4) FEINTING/DISTRACTION/BIG-POT TACTIC creates issues and goals some real and some made of straw. It requires you to stress unimportant or lesser points. You make concessions on these seem very important and cause your opponent to work very hard for small gains. Ultimately, when you get to the important issues, you will have the advantage, since you've already conceded a number of "important things." "I've compromised on 10 items, can you concede one?"	Have patience. Some issues lose importance/ignore some issues/suggest sweeping trades of unrelated issues/find out real issues in off-the-record discussions/protest/don't be satisfied with the bone; the other side wants to trade it for something important.
(5) FORBEARANCE/DELAY calls for holding off or stalling, rather than giving in immediately to your adversary's requests. If you give in too quickly, it will give your opponent a psychological advantage and establish a precedent as negotiations continue. Delay can cause your opponent to view a particular point in a different light. "I'll think about it and get back to you tomorrow."	Impose a deadline for agreement/threaten to withdraw or to pursue the exchange with a more cooperative person.
(6) PIECEMEAL is used to get your foot in the door. You go for a small piece rather than attempting to negotiate for the entire pie; start slowly and gradually enlarge your position. "I'll take only $250 now but let's renegotiate the next time I work for you."	

(7) REINFORCEMENT is using facts, data, and testimonials to support your points. "The law reads this way...."

Verify all proof/don't accept it just because it's in writing.

(8) TAKE A WALK is used when your opponent wants something more than you do. You give in graciously and build credit for the future. Let your opponent think you are surrendering something of worth, whether it is of value or not. "Although it's important to me, you can have it."

Be wary of any of your opponent's concessions/ask, "What will be expected from me in return now or later?"

(9) TRADE-OFF is making an offer in exchange for your opponent's concession. It's a question of giving and taking, voluntarily substituting and bargaining one item for another. Avoid using it too early in your negotiations. Make your opponent feel it's a good deal. Beware of offering too little or too much. "I'll come in on Saturdays if you come in on Sundays and Mondays."

Make a low counter offer and offer counter rationales in order to get more.

(10) TRIAL BALLOON/"WHAT IF?"is a method of presenting your opponent with options by prefacing your offer with the words "what if...." You don't commit yourself, but bring the item up for discussion and, at the same time, give your adversary the first right of refusal. "What if we could provide this kind of alternative—how would you feel about it?"

Use delay, since some "what if's" take time to answer/never price a "what if" on the spot/ check out his options—are they real?

(11) PRECEDENT is a method of justifying your resistance to a concession. "But if I do that for you I'll have to do it for everybody."

Emphasize that you will concede as a one-time gesture of goodwill/have alternative proposals designed to obtain the same concession (helps test the validity of his/her rationale).

(12) PERSISTENCE is a way of resisting concessions of important goals by repeating "no" several times until the other gives in, and it is to make concessions by repeating your demands several times. Persist in slightly different ways, express your points in a different light, and show your opponent that a particular concession might be warranted after all. "No" is a reaction, not a concept. "No, I can't accept this, but you can give me some more information on the subject."

Never accept "no" or "never" as a response/ repeat rationales/counter-rationales/probe for reasons for negative response.

(13) THE ULTIMATUM/TAKE IT OR LEAVE IT is letting your opponent know that it is your best offer, and that it represents the maximum in goal compromises you are prepared to make. Your opponent must either accept your offer or reject it, knowing that there will be no further offers. In reality, nothing stops you from making a new offer—in a face-saving way—once your take-it-or-leave-it offer has been rejected. Also, use it when your opponent can't afford to leave it. Don't use the words "take-it-or-leave-it" (it angers others). "This is my final and best offer."

Walk out/protest to higher management/ignore it/find out what you can do yourself and thereby reduce the price/leave face-saving avenue for opponent/get angry/let opponent know what he has to offer/introduce new alternative/beat him to it! Put final position in writing.

(14) THE NIBBLE is a method of asking for more when a deal is about to be closed. Once you have your opponent thinking he's about to close a deal, ask him for more "nibble," a small concession. The nibble succeeds because it is small compared with the whole deal. "Throw in a tie and I'll buy the suit."

Use ridicule—"you've got to be kidding"/insist that what he wants is not included in the deal/price the nibble in the sales price/have a visible published price and policy on extras.

(15) THE BOGEY is a "yes but" tactic. Yes, you'd love to close the deal, but you only have X amount of dollars. Use it when purchasing a relatively complex product or service because it helps to uncover available alternatives. Also, how can the other get hostile with someone who likes him and his product? "This is all I've got."

Test it (most budgets are flexible) offer alternative designs (some prepared beforehand)/ask for time to study the problem/change the shape of money/let the other do some things for himself to meet his own bogey/find out who has the money and who pays the final bill.

(16) DUMB IS SMART AND SMART IS DUMB is the Catch-22 of negotiation. It is not smart to be decisive, brilliant, quick, fully knowledgeable or totally rational. You'll probably get more concessions and betters answers if you are slow to understand, less decisive and slightly irrational. The trouble is that most of us want to look good. We find it hard to say "I don't know" or "tell me that again." "Could you explain that again?"

(17) THIRD-PARTY APPROVAL PROCESS is used when you appoint someone to be your shield to represent you and to check back with you for approval. Also, you can be a shield yourself and cannot make major decisions without getting approval from someone else. In this way you can use the tactic to coerce your opponent, or at least prepare him, to drop or reduce an objective. "It sounds good but I'll have to check with my wife."

Refuse to negotiate with anyone but the person who has the authority to make the final decisions/insist that the shield [illegible] re own authority to negotiate.

(18) THE CRUNCH involves saying something like "You've got to do better than that." It works since your opponent feels grateful for a second chance. Use it when all qualified bidders were given a second chance to improve their bids, when a severe budgetary limit exists, and when there is a doubt whether the bids reflect a true market sample. Don't overuse it, for it can lead to price-fixing. "You've got to do much better than that!"

Ask opponent whether others are offering the same product and service mix at a lower price/emphasize your quality service and performance as compared with others' low quality/make your concession contingent on getting something in return.

(19) ESCALATION involves increasing a demand to discourage additional demands of an opponent that he has gone as far as he can go. "You're forcing me to renege on yesterday's promise."

Call his bluff (he might want to start all over again)/get a large security deposit/get as many high-level people as possible to sign the agreement/counterescalate/get guarantee against escalation/walk away.

(20) BLUFFING can be defined as a position taken which is not fully supported by fact or logic but, which it is hoped, one's opponent will accept on the assumption that he enjoys such support. It is the art of creating illusions without the use of lies or outright misrepresentations. It's the difference between illusion and fraud. "I'm going to have to seek another contractor."

Examine your opponent's objectives and rationales. Do they logically support his position? /Cross-examine his rationales—do they hold up?

(21) SURPRISE happens when you introduce an unexpected behavior or a withheld goal at an unexpected point in the proceedings. Since your opponent will not have anticipated the objective, he will not have had the time to formulate counter rationales or counterbalancing concession requests from you. Consequently, you may be able to win the objective without having to yield anything. Introduce it at the very end of a negotiation in the hope that the weight of the common ground that has been established will permit the objective to be won. Used unjudiciously, it can create distrust, loss of face, and a communication block. Some examples of surprise tactics: escalation, deadlines, walk outs, recesses, new data, angry outbursts, an appeal to authority, a different negotiator, etc. "Before we close, I have just one more request."

Walk out/call a caucus/use delay/don't respond until you are prepared.

(22) INTENTIONAL DEADLOCK is reached when you indefinitely postpone your negotiation because no agreement can be reached. Your opponent may soften up soon after the deadlock and may be willing to compromise. It involves risk because some deadlocks can't be unlocked. "I quit."

Compromise/find a face-saving way out/change a team member or leader/postpone negotiation of difficult issues/share unknown losses and gains/sell them on a need for mutual satisfaction and for a cooperative effort/change type of contract/change percentage rate /call a mediator/arrange a summit meeting/add enticing options/change specs or terms/set up joint study committee/tell a funny story.

(23) ACCEPTANCE TIME involves giving your opponent time to get used to your proposals and ideas. People need time to accept anything new or different. "Think about it and I'll get back to you Wednesday."

(24) DEADLINES can be used when you want to force action and pressure your opponent into making an "either/or" choice. "I'll need your final decision by 2 o'clock."

Be skeptical of them (e.g., hotels will let you stay beyond 11 p.m. without charge)/find out about the other organization's production schedule, inventory picture and money pressures to see if deadline is real.

(25) LOWBALLING involves luring people into a deal at a low price without any intention of coming through. The hidden charges or conditions appear later when your opponent is tired and just wants to get the whole thing over with. "I forgot to mention a $100 carrying charge."

Walk away/know exactly what you want before negotiating/do your research/get full price with all add-ons included/ensure the specs changes are clearly understood and priced.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Business Management Department

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I. TITLE

Subcontract Management

II. REFERENCES

—Federal Acquisition Regulation (FAR), Parts 15.7, "Make-or-Buy Programs," and 44, "Subcontracting Policies and Procedures"

—DOD FAR Supplement Part 244.3, "Contractor Purchasing System Review"

—DAR Supplement No. 1, "Contractor Purchasing System Review (CPSR) Program"

—DSMC *Subcontracting Management Handbook*, 1988

III. POINTS OF CONTACT

—Local contracting office
—DOD Joint Contract Administration Coordination Committee
—Headquarters, Air Force Contract Management Division
Kirtland AFB
Albuquerque, N.M.
(505) 844-7725/7085/6280
AV 244-7725/7085/6280

IV. PURPOSE AND SCOPE

Describe the system and procedures available to the program manager for managing and controlling subcontractor performance.

V. POLICY

—The prime contractor is responsible for managing contract performance including planning, placing, and administering subcontracts as necessary to ensure the lowest overall cost and technical risk to the government.
—The legal doctrine of "privity of contract" precludes the program manager from directing a subcontractor's efforts, unless specific authority is included in the prime and subcontract.
—The program manager is responsible, through the prime contractor, for solving subcontractor problem areas that affect prime contractor's performance.

VI. DEFINITIONS

—Contract means a mutually binding legal relationship obligating the seller to furnish supplies or services and the buyer to pay for them.
—Prime Contract means any contract entered into by the government and a contractor to furnish supplies and/or services.
—Subcontract means any contract entered into by the contractor and a subcontractor to furnish supplies and/or services for performance of a prime contract.
—Subcontractor means any supplier, distributor, vendor, or firm that furnishes supplies or services to, or for, a prime contractor or another subcontractor.

VII. SUBCONTRACT MANAGEMENT

The complexity and technical capability of weapon systems has increased significantly during the past 20 years. This growth has generated the need to utilize skills and experiences of a wide range of firms to provide the systems. Prime contractors have obtained additional technical capabilities, beyond their areas of expertise, by subcontracting with firms that have the needed specialized skills.

The growth in subcontracting is demonstrated by an increase in subcontract value from approximate-

ly 20 to 60 percent of the prime contract value during the 20-year period. The increased dollar value of subcontracts has been accompanied by a need for additional integration and control of the prime and subcontractors activities, together with a need for program manager involvement in the decision-making process that influences system cost, schedule, and technical performance.

The program manager, and all representatives of the program office, must respect the privity of the contracting relationship between the prime and subcontractor to ensure that the prime contractor remains responsible for the total system. If the program manager directs specific action by a subcontractor, the government may become responsible and the prime then may be entitled to an equitable adjustment in the prime contract terms and conditions.

The effectiveness of subcontract management can be increased through the application of certain procedures available to the program manager for incorporation into the acquisition plan and/or resulting contracts. Following is a list of the procedures for improving subcontract management. The requirements for each prime contract should be tailored by the program manager to meet the specific program needs.

Subcontract Management Procedures

—Contractor purchasing system review
—Make or buy program
—Subcontract plan
—Consent to subcontract award

VIII. SUBCONTRACT MANAGEMENT PROCEDURES

—Contract Purchasing System Review (CPSR). A CPSR is an investigation and/or surveillance of a contractor's purchasing system. The objective of a CPSR is to evaluate the efficiency and effectiveness with which the contractor spends prime contract funds and complies with government policy when subcontracting. The CPSR provides a basis for granting, withholding, or withdrawing approval of the contractor' purchasing system.

A CPSR shall be conducted for each contractor whose sales to the government are expected to exceed $10 million during the next 12 months. A CPSR is conducted by the cognizant contract administration agency at least every 3 years, or on a continuing basis. A more frequent CPSR cycle may be established, and special reviews may be conducted if problem areas are identified. The DAR Supplement No. 1 contains guidance for conducting the CPSR.

A CPSR requires complete evaluation of the contractor's purchasing system with special attention to such matters as: degree of price competition, pricing policies and cost analysis, treatment accorded affiliates, socioeconomic programs, award and post-award management of subcontracts, and appropriate use of contract types. The CPSR results are documented and transmitted to the contractor by the administrative contracting officer. Each Military Department will establish controls to assure maintenance of a viable surveillance program.

—Make-or-Buy Program. A make-or-buy program is that part of a contractor's written proposal identifying major items to be produced or work efforts to be performed in the prime contractor's facilities, and those to be subcontracted. The objective of the program is to help evaluate a contractor's technical and cost proposal, provide clarification and data for contract negotiations, and control changes to the negotiated program after contract award.

A program normally will be requested from prospective contractors in the solicitation for all negotiated contracts whose estimated value is $2 million or more. The program shall be confined to those major items of work efforts that would normally require company management review of the make-or-buy decision because of complexity, cost (exceed 1 percent of contract price), or other factors.

The prospective contractor's proposal should include a make-or-buy program that contains the following: description of each item, categorization of each item (must make, must buy, or can either make-or-buy), proposal to either make-or-buy each item, and recommended source including interdivisional transfers. The program will be negotiated and included in the contract. The contractor's recommendations should be accepted unless they are inconsistent with government interest or policy The government shall give primary consideration to the effect of the proposed program on price,

delivery, quality, and performance, including technical or financial risk involved.

Changes to the make-or-buy program are controlled by a contract clause that is mutually agreed upon (FAR Part 52.215-21). Alternative provisions may be included in the contract depending on the extent of government change control.

—*Subcontract Management Plan.* A subcontract management plan is the part of a contractors written proposal that identifies major/critical subcontractors who will receive special management attention, and the related subcontract administration plans. The objective of the plan is to identify major/critical subcontractors, develop government and prime contractor working relationships for subcontract management action, and provide surveillance procedures of subcontractors to assure prime contract requirements will be met.

The solicitation can require prospective contractors to submit a plan as part of its proposal when the program manager and local contracting officer deem special emphasis and control techniques are appropriate. The plan should include a description of the contractor's organization and control approach for the specific prime contract; identification of major/critical subcontractors; alternative plans for high-risk subcontractors; special provisions to be included in the prime contract and passdown provisions to be included in subcontracts.

Contract negotiations of the plan should stress major/critical subcontractors, provide for surveillance and reports, and give the government access. Major/critical subcontractors should be evaluated in terms of program risk and alternative planning if problems develop. The plan, and implementing contractual provisions, should be flexible for adding and deleting major/critical subcontractors during contract administration. The prime contractor shall require special progress reports from the subcontractor and provide copies to the program manager. The prime contract should contain provisions authorizing the program manager to attend meetings and review status programs at the subcontractor's facilities.

The AFSC FAR Supplement 52-244.9000, "Subcontract Management Plan," (April 1984), and 52.244.9001, "Subcontract Management," (May 1981) provide examples of solicitation and prime contract clauses. The program manager and local contracting officer may consider other methods of establishing a strong working relationship with the prime contractor and subcontractor; such as, team building meetings with all parties involved, incentive-award fee provisions, scheduled top management meetings, and/or incentive performance provisions.

—*Consent to Subcontract Award.* Consent to subcontract means the contracting officer's written consent for the prime contractor to enter into a particular subcontract. The objective of government consenting to the placement of a subcontract is to review the prime contractors, pass down provisions to subcontractors, and to monitor its performance. The prime contractor is documenting performance of its purchasing system for government review. The government's consent to a subcontract does not obligate the government in any way, or change the prime contract relationship.

Review of proposed subcontracts is a contract administration function normally delegated to the administrative contracting officer. The program manager can ask his procurring contracting officer to withhold or limit this delegation for performance of subcontract review and consent. The requirement for government review and consent is established in the prime contract general provisions, FAR Parts 52.244-1 through 52.244-5. The contracting officer responsible for consent shall review the request and supporting data and consider the following:

(1) Is the decision to subcontract consistent with the contractor's approved make-or-buy program if any?

(2) Is the subcontract for special test equipment or facilities that are available from government sources?

(3) Is the selection of the particular supplies, equipment, or services technically justified?

(4) Has the contractor complied with the prime contract requirements regarding labor-surplus area or small-business subcontracting including, if applicable, its plan for subcontracting with small-business concerns and small-disadvantaged business concerns?

(5) Was adequate price competition obtained, or its absence properly justified?

(6) Did the contractor adequately assess and dispose of subcontractors' alternate proposals, if offered?
(7) Does the contractor have a sound basis for selecting and determining the responsibility of the particular subcontractor?
(8) Has the contractor performed adequate cost or price analysis or price comparisons and obtained accurate, complete, and current cost or pricing data, including any required certifications?
(9) Is the proposed subcontract type appropriate for the risks involved, and consistent with current policy?
(10) Has adequate consideration been obtained for any proposed subcontract that will involve the use of government-furnished facilities?
(11) Has the contractor adequately and reasonably translated prime contract technical requirements into subcontract requirements?
(12) Does the prime contractor comply with applicable cost accounting standards for awarding the subcontract?
(13) Is the proposed subcontractor on the Consolidated List of Debarred, Suspended, and Ineligible Contractors?

IX. SUMMARY

Subcontract management is probably one of the least understood facets of program management. The program manager must maintain a delicate balance between the government being informed, and directing the subcontractor to take actions for which the government would become liable. The program manager should anticipate potential problem areas with subcontractors and take necessary action to define the government's role in subcontract matters in the prime contract. The need for involvement has been confirmed by several surveys. However, all program manager activities must be implemented through the prime contractor to ensure that it retains the responsibility for prime-contract performance.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Business Management Department
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I. TITLE

Contract Administration

II. REFERENCES

—Federal Acquisition Regulation (FAR) Subpart 42

—DODI 4105.59-Subject: "DOD Plant Cognizance Program"

—DOD 4105.59-H, "DOD Directory of Contract Administration Services Components, Annually"

—DODI 4105.64-"Technical Representatives at Contractors' Facilities"

III. POINTS OF CONTACT

—Office of Secretary of Defense
Directorate of Contract Policy and Administration
OUSDRE (AM) CA
Washington, D.C. 20301-3062
(202)697-2571
—Defense Logistics Agency
Directorate of Contract Management (DLA-A)
Cameron Station
Alexandria, VA 22314
(703) 274-7093
—For Army Plant Representative Offices (ARPROs)
U.S. Army Aviation Systems Command
AMSAV-P
St. Louis, MO 63120
AV 693-3125
—For Navy Plant Representative Offices (NAVPROs)
Appropriate Systems Command; e.g., NAVAIR
—For Air Force Plant Representative Offices (AFPROs)
Headquarters Air Force Contract Management Division
AFCMC/CS
Kirtland AFB, NM 87117
—Local CAS organization

IV. PURPOSE AND SCOPE

To present an overview of contract administration, the primary players, their functions and the significance to a program manager.

V. POLICY

The number and variety of DOD components with which industry must deal on contract administrative matters shall be kept to a minimum in order to:
—Improve contract administration in the field
—Provide timely and uniform support by Contract Administrative Service (CAS) components to purchasing offices, program managers, and other acquisition organizations
—Eliminate duplicating effort
—Decrease operating costs
—Increase uniformity in the performance of contract administration
—CAS components are the designated representatives of DOD for administration of contracts, and, as such, shall be utilized to the maximum extent possible to perform those functions required at, or near, contractor-operated plants.
—The basic policy provides for plant cognizance to be performed by the Defense Contract Administrative Service (DCAS). The military services may, on an exception basis, request cognizance of a specific contractor plant if certain criteria are met (DODI 4105.59 E5). The service must have a large proportion of the business in that plant and have contracts for major systems or subsystems of high technical complexity. If OSD approves a service request for a service plant office, that Contract Administration Office (CAO) will provide CAS support to all other DOD agencies.

—The functions listed in the FAR Subpart 42-3 shall be performed at contractor-owned or operated facilities by the responsible DOD CAS component. The purchasing office may retain responsibility for administration of contracts listed in the DOD FAR Supplement Subpart 42.203, contracts not requiring administration functions at or near contractor facilities, or for contract administration functions otherwise agreed upon in formal interagency arrangements.

—To the maximum extent practicable, program managers shall delegate *technical* functions requiring performance at contractor's locations to the cognizant CAS components.

—If technical requirements cannot be satisfied by CAS components, *program managers may attach tech reps to CAS components* to perform program technical functions, liaison, and to provide guidance and assistance to CAS components. This assignment must be made in writing IAW DODI 4105.64 Vc.

VI. DEFINITIONS

—*Contract Administrative Services.* Those functions accomplished in or near a contractor's plant for the benefit of the government which are necessary to the performance of a contract or in support of the buying organization. Among the more significant functions performed by field contract administrative components are the following: (a) contract administration, (b) quality assurance, (c) engineering, (d) production and industrial resources, (e) subcontract management, (f) industrial materials management, (g) industrial security, and (h) transportation.

—*Contract Administration Services Component.* A field activity of Defense Contract Administration Services or a military department, performing contract administration services on contracts with private industry in a designated geographic area or at a specific contractor's plant.

—*Plant.* A structure or group of structures on a contiguous site operated by a single contractor to perform DOD contracts. Contractor-operated facilities of all types, including those owned by the government and non-profit organizations, are considered plants. Plants of the same corporation substantially dedicated to supporting a main plant, but not located on the contiguous site, may be considered for cognizance assignment to the CAS component responsible for the main plant, based on justification that clearly demonstrates the need for a single CAS component to have cognizance of the main plant and the satellite or feeder plant. (Assignments of cognizance of these "off-site" locations shall be recorded in DOD 4105.59-H)

—*Plant Cognizance.* The responsibility for performance of CAS on all contracts in a contractor's plant. This responsibility is assumed by the DLA at all plants except those specifically assigned to the military departments by the DUSD(AM).

—*Technical Representative.* A representative of a DOD component other than a representative of a CAS or contract audit component, performing technical functions in or near a contractor's plant.

General

Contract Administration Services are an integral part of every phase of the acquisition cycle. They are performed by a variety of organizations in different agencies. These organizations are structured and operated differently, but all comply with the FAR and supplemental DOD policy. Program office personnel are likely to interface with many of these CAS organizations when working different contractor related matters. Consequently, program personnel should be familiar with these organizations and their functions to maximize their support to the program.

CAS Components

Almost all weapon system contracts are assigned to a single CAS component designated to provide plant cognizance for that contractor's facility. This function of the single DOD representative for contract administration is generally performed by the Defense Contract Administration Service (DCAS), which is part of the Defense Logistics Agency (DLA). The DCAS is divided into nine geographical regions, which are further subdivided into management areas. The DCAS has about 16 thousand people providing plant cognizance for more than 20 thousand contractor facilities. Much of their effort is performed on an itinerant basis; i.e., often dealing with the contractor on an as-needed basis, rather than full-time basis. When a particular contractor's plant has a very large amount of a defense business, a CAS team will be located at that facility on a full-time basis. This team, generally called a plant representative office, may belong to DCAS

as a DCASPRO, or it may answer to one of the services as an Army Plant Representative Office (ARPRO); a Navy Plant Representative Office (NAVPRO) or a supervisor of Shipbuilding, Conversion, and Repair, USN (SUPSHIP); or as an Air Force Plant Representative Office (AFPRO).

Although designations change, there are generally about 40-45 DCASPROs, three (3) ARPROs, 15 NAVPROs, 16 SUBSHIPs, and 25 AFPROs. In addition to the DCAS system and the plant representative offices, CAS is provided by the Office of Naval Research for all educational institutions that contract with the DOD, and by overseas and special commodity CAS agencies. A full list of CAS components is found in the DOD Directory of CAS Components (DOD 4105.59 H).

In practice, most major prime contractors for weapon systems like missiles, planes, helicopters, and personnel carriers will have an in-house plant representative office which deals exclusively with that contractor. The program manager needs to establish an effective working relationship with this office. The PM must recognize, however, that many smaller contractors and subcontractors on his/her program will not justify an in-plant office and will receive itinerant surveillance by the responsible DCAS management area. In such cases, the DCAS will provide surveillance by designated functional specialists who deal repeatedly with that and other designated contractors. Thus, whether or not a contract is administered by a plant representative office, both the PM and the contractor can expect to deal repeatedly with the same government plant cognizance people. This continuity adds efficiency and stability to the government-contractor interface.

Other Agencies

Most Contract Administration Services are provided by the CAO. Several important areas of CAS, however, are provided by other agencies. For example:

The Defense Contract Audit Agency (DCAA) provides audit of the contractor's accounting system and cost records. The DCAA works in concert with, but is not part of, the CAO. It is a separate agency assigned to the Assistant Secretary of Defense (Comptroller).

The Defense Investigative Service provides review of the contractor's industrial security program and security clearances for contractor personnel.

The Department of Labor provides review of the contractor's affirmative action program known as the contract compliance review.

Functions

The FAR lists more than 60 CAO functions. Some are in support of specific programs and/or contracts while other functions relate to the overall activity of the particular plant in its role as a defense contractor. For a complete list of CAS functions see FAR subpart 42.3. In general, however, the CAO provides:

—Administration of routine matters relating to items like payments, billings, packaging, certificates, name changes, etc.

—Government functions related to contractor costs including negotiation of forward pricing rates, cost monitoring, determinations related to cost-accounting standards, and monitoring financial conditions.

—Pricing support for contract cost negotiations.

—Ensuring contractor compliance with contractual quality assurance requirements.

—Surveillance of the contractor's progress against contract production schedules.

—Pre-award surveys.

—Evaluation and surveillance of contractor engineering efforts and engineering management systems.

—Evaluation and surveillance of many contractor management systems including compensation, insurance, pensions, estimating, government property administration, purchasing, cost/schedule control, and quality systems.

In regard to this last point, it is important to realize that the CAO generally reviews a contractor's system for doing most functions. If the system is adequately designed to provide the information and/or control required by the government a periodic sampling audit of system function and output is usually sufficient to protect the government's interest.

CAO Perspective

Contract administration is generally thought of as the post-award management of a specific contract. Certainly, a good deal of the CAO effort is spent managing specific contracts and in support of specific PMOs on both pre-award and post-award

bases. There is, however, the other major mission of the CAO, the responsibility to evaluate and monitor the contractor's management systems. These systems impact all the programs in-plant. Evaluation and surveillance are ongoing tasks related to the company being a sizable government contractor, rather than because the contractor has any specific contract. For example, a CAO evaluates a cost proposal in support of a program office but the CAO also evaluates the contractor's cost estimating system to assure the contractor has an acceptable method for estimating cost and that the contractor is following that method.

It is important to recognize the dual focus or responsibility of the CAO because the CAO interface with the contractor's management system can affect the way the contractor and/or the CAO interact with a program. What may be best for one program may have a negative impact on other programs and/or the contractor. The CAO must balance the needs of one program, the interest of other government programs, legal and administrative requirements, and legitimate interests of the contractor. An understanding of this multiple focus by the CAO will enable the program manager to utilize CAO resources better.

PM/CAO Coordination

As the government representative at the contractor's facility, the CAO is a key member of the acquisition team. Coordination and cooperation between the PMO and CAO enhance the chances for a successful program. When a contract is awarded, it will be assigned to the appropriate CAS element. The CAO will perform the functions listed in FAR Subpart 42.302 to the extent required to support the contract. The addition or deletion of functions needs to be coordinated with the CAO. An excellent mechanism for achieving coordination is the establishment of a memorandum of agreement (MOA) that specifies which functions will be done by the CAO and which by the PMO. In addition, the CAO, contractor, or PMO may desire to conduct a post-award conference to assure that all parties understand the contract requirements. On a continuing basis, all correspondence to and from the contractor concerning the contract should be sent through the CAO, and government visits to the contractor should be coordinated with the CAO.

In addition to these relatively formal vehicles for PM/CAO coordination, frequent telephone communication from the PM or staff and including the CAO in program planning meetings pays big dividends. Make sure the CAO is aware of special or unusual areas of emphasis on a program. Make sure the CAO can support those special requirements. A CAO knowing the PMO personnel and their program objectives is more likely to provide timely and effective information and support.

The CAO represents a pool of talent in many functional disciplines. In addition to their functional skills, CAO personnel probably have greater overall knowledge of a contractor's operation than does a single program office. Because of their routine contact with the contractor or, they are able to act as eyes and ears of the government acquisition team. The CAO services are funded directly and generally require no payment from a DOD buying agency for a U.S. purchase. The PM who recognizes the resources available at the CAO, along with the need to keep the CAO informed, is likely to improve the contract management on the program.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

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I. TITLE

Contract Changes

II. REFERENCES

—Federal Acquisition Regulation (FAR), Part 43, *Contract Modifications*; and Clause at 52.243-7, *Notification of Changes.*
—DOD FAR Supplement, Part 243
—NAVMAT Training Manual (1980), Contracting Management for Technical Personnel, Part C, *Contract Modification.*
—U.S. General Accounting Office (1980), compiled in the Office of General Council, Government Contract Principles, Third Edition, 1980, Chapter 6, *Performance of Government Contracts.*

III. POINTS OF CONTACT

Local Contacts (or Procurement/Production) Office

IV. PURPOSE AND SCOPE

This fact sheet is designed to:
—Describe the essence of a major contract modification: Contract changes.
—Explain the difference between Change Orders and supplemental agreements.
—Explain the proper way to price changes.

V. DEPARTMENT OF DEFENSE POLICY

Only contracting officers acting within the scope of their authority are empowered to execute contract modifications on behalf of the government. Other government personnel shall not: (1) execute contract modifications; (2) act in such a manner as to cause the contractor to believe that they have authority to bind the government; or (3) direct or encourage the contractor to perform work that should be the subject of a contract modification. (FAR 43.102).

(As used here, contract modifications include both change orders and supplemental agreements. Beyond this narrow definition, of course, contract modifications include actions under such clauses as terminations,(see Fact Sheet 3.12.1), Stop Work Orders, government property, escalation, and other pricing revision clauses).

VI. THE CHANGES CLAUSE

The contract clause entitled "Changes" distinguishes government contracts from other contracts by the control over performance vested in one of the contracting parties. Unlike commercial contracts where performance must conform to preagreed terms in the absence of a modification issued by both parties, the changes clause in a government contract allows the government to alter the work to be performed without the consent of the contractor.

The standard changes clause provides, in essence, that the contracting officer may, by written order, make any change in the work within the general scope of the changes clause of the contract. Such changes may result also in an appropriate upward or downward equitable adjustment in the contract price, delivery schedule or time for performance.

Additionally, the clause provides that a dispute over the equitable adjustment shall be a question of fact under the disputes clause and that nothing in the clause shall excuse the contractor from proceeding with the contract as changed. This power, unique to government procurement, allows the contracting officer to alter performance without un-

necessary interruption and to subsequently negotiate and, if necessary, determine the appropriate contract price adjustment.

The standard changes clause imposes certain common requirements for issuing valid change orders. The first of these requirements is that the change be ordered by the contracting officer. This literal requirement has been relaxed in certain cases to cover changes directed by engineers and inspectors through the theory of ratification by the contracting officer or through an actual or implied delegation of authority. The clause also states the change must be made by written order. However, this requirement has been generally ignored by the courts. This is especially true since the development of the theory of constructive change orders. A constructive change is one where the contracting officer, through actions or directions, has changed the work to be performed but failed to issue a written change order.

The constructive change theory often is used to allow administrative settlement of cases involving defective or impossible specifications and for acceleration of performance situations where the contractor encounters excusable delays known to the government but for which the government refuses to extend the performance time.

One of the more important requirements of a valid change order is that the change ordered must come within the general scope of the contract. Changes in work which go beyond the limits or scope of the contract are referred to as cardinal changes and constitute a breach of contract. Generally a change is within the scope of the contract if the work ordered is essentially the same as that contemplated and bargained for at the time of contract formation.

Both the standard changes clause for fixed-price supply contracts and the changes clause for cost reimbursement-type contracts authorize the government, by written order of the contracting officer, to make changes *within the general scope of the contract in the:*

—Method of shipment or packing.
—Place of delivery.
—Specifications

The number of changes ordered does not, per se, dictate the work to be beyond the scope of the contract. Change orders can have added and deleted work, accelerated performance, and altered specifications, drawings or inspection and still be within the general scope of the contract.

The equitable adjustment provided for by the changes clause is for the purpose of making the contractor whole for any modification by the government. The adjustment may be made in terms of contract price, delivery schedules, or both, and may be a decrease, as distinct from an increase, where the change by the government reduces the cost of performance. The equitable adjustment to the contract price for extra work caused by a change includes a profit on such work in addition to the cost of the work. Current changes clauses provide that an equitable adjustment shall also cover increases in cost to the unchanged work which may result from the change order.

In planning contract modifications, project personnel must be alert to the problem of changes that may go beyond the scope of the original agreement. The rule is that, changes not provided for in the initial contract are funded as new procurement. While this is basically a legal consideration—and counsel should be consulted when advice is needed—all personnel involved in the acquisition process may face one or another aspect of it during contract life. During the contract administration phase, the problem may be particularly acute for those contemplating change orders, for example. The following modifications may be considered to be beyond the scope of the contract, thus requiring the use of a supplemental agreement (a bilateral action) rather than a change order (a unilateral action):

—Any change in the essential character of the supplies or services initially called for.
—Any requirement for work, effort, or services beyond those required by the original contract schedule.

The cumulative effect of the change clauses is to give the government an extraordinary control over the performance of its contracts and to establish by contract the measure of reimbursement to be given to contractors when the government exercises these rights. This power becomes even more remarkable when coupled with the disputes clause of the contract which establishes the contracting officer as the initial arbiter of any dispute arising under the contract and makes his decision final

on questions of fact subject to an appeal to the Armed Services Board of Contract Appeals. More importantly, it requires the contractor to perform in accordance with the contracting officer's decision pending final decision of a dispute.

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I. TITLE

Contract Terminations

II. REFERENCES

—Federal Acquisition Regulation (FAR), Part 49, *Termination of Contracts*

—DOD FAR Supplement, Part 249

—NAVMAT Training Manual (1980), *Contract Termination*, Part F

—U.S. General Accounting Office (1980), Compiled in the Office of General Council, Government Contract Principles, Third Edition, 1980, Chapter 6, *Performance of Government Contracts*

III. POINTS OF CONTACT

Local Contracts (or Procurement/Production) Office

IV. PURPOSE AND SCOPE

This fact sheet is designed to:
—Describe the difference between Convenience and Default terminations.
—Describe the processing of a termination action.
—Explain the financial liabilities of both the government and the contractor resulting from a termination action

V. DEPARTMENT OF DEFENSE POLICY

Only contracting officers acting within the scope of their authority are empowered to execute contract modifications, including termination actions, on behalf of the government. Other government personnel shall not: (1) execute contract modifications; and (2) act in such a manner as to cause the contractor to believe that they have authority to bind the government. (FAR 43.102).

(As used here, contract modifications include both convenience and default termination actions. Beyond this narrow definition, of course, contract modifications include actions under such clauses as Changes Clauses (see Fact Sheet 3.12), Stop Work Orders, Government Property, Escalation, and other pricing revision clauses).

VI. THE TERMINATION CLAUSES

In general, government contracts provide for termination prior to completion for two reasons: for the convenience of the government and for default of the contractor. The government may terminate for its convenience at any time during performance even though the contractor is performing properly; the contractor assumes this risk under the contract terms whenever he does business with the government. When it makes use of this right, however, the government must compensate the contractor for his preparations and for any completed and accepted work that relates to the terminated part of the contract. The government may terminate for default when the contractor fails to perform his part of the bargain properly. In addition, the default clauses provide that an erroneous default termination shall be considered a termination for convenience. Currently, the major procurement regulations make the inclusion of a termination for convenience clause mandatory.

The real effect of the convenience termination clause is to establish the measure of compensation the contractor may recover for the government's termination of the contract. In the absence of this contract right, the unilateral repudiation of a contract would be a breach of contract. In a

Table 1. DEFENSE CONTRACT TERMINATION ACTIONS*

TERMINATION FORM	CLASS OF CONTRACT (any type)	RECOVERY OF FUNDS BY THE CONTRACTOR: COST	RECOVERY OF FUNDS BY THE CONTRACTOR: PROFIT/FEE
CONVENIENCE OF THE GOVERNMENT Reason: Any legal purpose; i.e., •Changed requirement •Abandoned program •Revised budget Termination can be: •Complete •Partial	Fixed Price	Reimbursement of allowable costs (and profit), including all costs related to the termination action: can be up to 100 % of contract price. (49.207 and 52.249-2)	Allocable portion of profit (or loss), had contract not been terminated, on all work-in-process. (49.202(a) and .203(a))
	Cost Reimbursement	Reimbursement of allowable costs beyond, if necessary, the current estimated (or target) cost, with proper contract modification. (49.303-1 and 52.249-6)	Allocable portion of fixed, base or target fee commensurate with percentage of work completed. Additionally, in a Partial Termination, estimated (or target) cost and fee may be adjusted downward. (49.304-1 and .305-1)
DEFAULT OF THE CONTRACTOR Reasons: Failure to: •Deliver on time •Meet specs •Make progress (49.402-1)	Fixed Price	None (if no work prior to the termination is accepted), plus contractor must pay cost of reprocurement by government. (49.402-6 and 52.246-2 (f) and (h))	If no work prior to the termination is accepted, no profit is received. (49.402-6 and 7)
Reasons: Due to: •Fraud •Knowingly employing incompetent key personnel •Abandonment of effort (52.246-3(h))	Cost Reimbursement	All allowable costs except no recovery of termination settlement expenses or correction or replacement costs. (49.403 and 52.246-3(g) and (h))	If no work prior to the termination is accepted, no fee is received. (52.249-6(g)(4)(ii))

*All references are to the Federal Acquisition Regulation (FAR) as of 1 October 1984.

breach of contract the aggrieved party may recover his expected or anticipated profits as damages. However, under the clause the contractor recovers only his costs and the profit earned on work actually accomplished and later only if he is in a profit position at the time of termination.

The termination for default clauses set forth the rights of the government in case the contractor fails to perform or make progress under the contract. The clauses prescribe the procedures for invoking default termination, the contractor's liability, and the result when a termination for default is improperly made.

When the government terminates a contract for default, the clause provides the contractor shall be liable for excess costs of reprocurement, and liquidated damages accrued or, in the absence of liquidated damages, the actual damages suffered by the government. The last provision of the standard default article provides that the rights and remedies of the government under the clause are in addition to any other rights and remedies provided by law or contract clause.

The compelling effect of the contract clause for default is to give the government extraordinary control over the performance of its contracts. This power becomes even more remarkable when coupled with the Disputes clause of the contract which establishes the contracting officer as the initial arbiter of any dispute arising under the contract and makes his decision final on questions of fact subject to an appeal to the Armed Services Board of Contract Appeals.

Table 1 summarizes the financial liabilities of both the government and the contractor under convenience and default actions.

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I. TITLE

Data Rights

II. REFERENCES

—Federal Acquisition Regulation (FAR), Part 27

—DOD FAR Sup, Part 227

—Defense Acquisition Improvement Act of 1986 (Pub Law 99-500)

—Defense Acquisition Improvement Act of 1988 (Pub Law 100-180)

III. POINTS OF CONTACT

—Your patent data rights attorney.
—Your contracting officer.

IV. PURPOSE AND SCOPE

This fact sheet is designed to briefly describe policies, definitions, categories, and considerations pertaining to technical data rights in the systems acquisition process.

V. POLICY

The Department of Defense (DOD) has issued policy, resulting from the Defense Acquisition Improvement Acts of 1986 and 1988 relating to rights in technical data. This policy defines, in clearer terms, the position of the government on this subject. In general, new DOD emphasis is to acquire only data rights essential to meet minimum government needs. This new emphasis is centered around creating a balance between the government need for technical data and the protection of the contractor economic interest. Contractors may be reluctant to provide technologically superior products to the government if their economic interests are not protected. At the same time, the government is committed to maintaining a competitive environment and industrial base. Therefore, it is essential that an appropriate data rights needs assessment be done early in the acquisition process of any item, component or process. This identification should be done prior to contract award or prior to full-scale development for major weapon systems.

VI. DEFINITIONS

—Technical Data. Recorded information, regardless of the form or method of the recording of a scientific or technical nature (including computer software documentation).

—Developed. The item, component, or process exists and is workable. Thus, the item or component must have been constructed or the process practiced.

—Private Expense. Development cost has not been paid in whole or in part by the government and such development was not acquired as an element of performance under a government contract or subcontract. (Independent Research and Development/Bid and Proposal cost fall in the category of private expense).

—Restricted Rights. Rights that apply only to computer software and include, as a minimum, the right to:

—Use computer software with the computer for which or with which it was acquired.

—Use computer software with a backup computer if the computer for which it was acquired is inoperative.

—Copy computer programs for safekeeping or backup purposes.

—Modify computer software, or combine it with other software, subject to provisions that the portions of the derivative software incorporating restricted rights software are subject to the same restricted rights.

—Proprietary Rights. A broad contractor term used to describe data belonging to the contractor. This data could be intellectual property, financial data, or even classified material. This is not a category accepted by the government when referencing technical data. When it is used in reference to technical data, a determination is needed on which of the three accepted categories it falls within—unlimited, limited, or government purpose license rights.

VII. TECHNICAL DATA RIGHT CATEGORIES

—Unlimited Rights. If the government has funded the entire development of an item, component, or process, it is entitled to, or will normally obtain, unlimited rights. This means the government has the right to use, duplicate, or disclose technical data in whole or in part, in any manner and for any purpose whatsoever, and to have or permit others to do so.

—Limited Rights. If the contractor has developed an item, component, or process exclusively at private expense, then the government is entitled to limited data rights if the item, concept, component or process is required in the performance of a government contract. This allows the government to use, duplicate, or disclose technical data, in whole or in part within the government; however, the government may not use this data for manufacture or for preparing the same or similar computer software. It may also release the data outside the government for emergency repair or overhaul or to a foreign government if in the interest of the United States and required for evaluation or information.

—Government Purpose License Rights (GPLR). An exception to unlimited rights is GPLR. The government may wish to accept GPLR for technologies developed under government contracts in order to encourage commercializing those technologies. The government shall retain the royalty-free right to use, duplicate, and disclose data for government purposes only and to permit others to do so for government purposes only for a stated period of time. Government purposes include competitive procurement, but do not include the right to permit others to use technical data for commercial purposes.

VIII. CONSIDERATIONS

If the technical data was developed with mixed funding (part government, part contractor), the contracting officer will negotiate with the contractor for the time period before GPLR will expire and the data reverts to unlimited rights. Negotiation shall begin at the earliest possible time and the results shall be incorporated into the contract, preferably at time of award, but in any event before delivery of the data.

The contractor is required to notify the government of any technical data subject to private expense (limited rights) or mixed funding development. In the absence of this notification, the government shall have unlimited rights.

If the contractor identifies data developed at private expense and the government concurs, then the contracting officer may negotiate with the contractor to acquire additional rights where appropriate.

In determining whether unlimited or GPLR are required, consideration should be given to such factors as: whether or not the item, component, or process will be competitively acquired; whether repair and overhaul work will be contracted out or serviced in-house; whether the repair or replacement parts will be commercial items, or acquired by form, fit or functional data, performance specifications, or by detailed engineering drawings. In deciding how to acquire such data and data rights, it is DOD policy to use procedures that are the least intrusive on the contractor's economic interest as is practicable.

*Note: Portion of the definitions in Part VI and VII have been reprinted verbatim from one or more of the references in Paragraph II of this fact sheet.

INSERT TAB 4

ENGINEERING MANAGEMENT

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 4.1
Version: Update
Date: December 1988

I. TITLE

The Engineering Process

II. REFERENCES

—MIL-STD-499A, " Engineering Management"

—*System Engineering Management Guide*, Defense Systems Management College

—MIL-STD-1521B, "Technical Reviews and Audits for Systems, Equipment and Computer Software"

—"Solving the Risk Equation in Transitioning from Development to Production." Defense Science Board

—DOD Directive 5000.1, "Major and Non-Major Defense Acquisition Programs"

—DOD Directive 5000.3, "Test & Evaluation"

—DOD Directive 5000.29, "Management of Computer Resources in Major Defense Systems"

—DOD Directive 5000.39, "Acquisition and Management of Integrated Logistic Support for Systems and Equipment"

—DOD Directive 4245.3, "Design to Cost"

—DOD Directive 4245.6, "Defense Production Management"

—DOD Directive 4245.7, "Transition from Development to Production"

III. POINTS OF CONTACT

—Undersecretary of Defense for Research and Engineering

—Technical Management Department, Defense Systems Management College

IV. PURPOSE AND SCOPE

This fact sheet is designed to:

—Provide a description of the purpose of the engineering process

—Identify the major activities that make up the process

V. DOD Policy

Improved readiness and sustainability are primary objectives of the acquisition process. Resources to achieve readiness will receive the same emphasis as those required to achieve schedule or performance objectives. A cost-effective balance must be achieved among acquisition costs, ownership costs of major systems, and system effectiveness in terms of the mission to be performed.

VI. THE ENGINEERING PROCESS

The past several decades have seen the rise of large, highly interactive defense systems that are often on the forward edge of technology. These systems have a natural process of evolution, or life cycle, in which actions taken or avoided in the very early stages can mean the difference between success and failure downstream.

The system life cycle consists of the interval from program initiation to system disposal. All activity in the acquisition process centers around the system. Thus, the state of definition of the system configuration at any time in the system life cycle is an area of common interest among all disciplines. Phases in the defense systems life cycle are promulgated by the Department of Defense as concept exploration/definition, concept demonstration/validation, full-scale development, full-rate production/deployment, and operation and support.

The division of technical activities into functional areas of engineering, test, manufacturing, and logistic support is convenient and usually results in a corresponding division of labor in a program office. As can be seen from Figure 1, each of these functional areas is active in the earliest phase of the life cycle and continues through most of the program. The general thrust of technical management goes like this:

—*Define* what it takes to support, produce, and test the system. Then see if we can afford it.

—*Influence the design* through producibility engineering, logistics analysis, testability design, and design to cost. Develop specifications and translate requirements to contract language.

—*Prepare to execute* by arranging for the test facilities, acquiring and setting up the production line, and designing and acquiring the logistic support.

—*Execute* by testing, manufacturing, and supporting.

Acquisition of a system is a process that begins with the identification of a need. The goal of a system acquisition is to deploy (in a timely manner) and sustain an effective system that satisfies the need at an affordable cost.

Thus, the effort involved in the acquisition process can be modeled as an input, process, and output. The output is the system. The input is the need and other appropriate constraints. The process consists of managing the technical activities by establishing and maintaining a balance among cost (the resources required to acquire, produce, operate and support, and dispose of a system), system effectiveness (the degree to which a system can be expected to achieve a set of specific mission requirements), and schedule. Much of the criticism leveled at Defense results from a perception of imbalance among these three factors.

To summarize, management of the acquisition process can be defined as the logical and systematic conduct of the effort required to transform a military need into an operational system.

A system life cycle can span 30 years or more. Technical activities over the life cycle are not discrete events. Each activity is present in some form throughout a system's life cycle.

Successful acquisition and support of a system requires a cooperative effort on the part of government and industry, since the capability of the Industrial Base to economically produce defense systems on a timely basis is a key element of the acquisition process.

VII. MAJOR ACTIVITIES IN THE ENGINEERING PROCESS

Figure 1 presents a time schedule of major activities in the engineering process over the life cycle. Functional definitions follow:

Contract. The document that defines the government/industry agreement.

RFP, SOW, SPEC, and CDRL (Request for Proposal, Statement of Work, Specification, and Contract Data Requirements List) are documents used in letting contracts for each phase of work. The RFP sets forth the needs, the SOW is the formal statement of these needs as requirements for contractual effort, the specification sets forth the technical requirements and the CDRL definitizes the data deliverables.

Systems Engineering

Systems Engineering Management Plan (SEMP). A formal document which includes plans for verification, risk alleviation, analyses and simulation of system requirements.

Preplanned Product Improvement (P^3I). A deliberate decision delaying incorporation of a system capability but providing growth allocations for the capability.

—Product Definition

Operational Requirement. Statement of the mission needs.

Technical Requirements Formulation. The process of coverting operational requirements into technical requirements that can be acted on by designers.

Requirements Scrub. Review of user/government comments received in response to announcement of an operational requirement. The scrub is used to validate and prioritize suggested/requested system functions/capabilities before release to industry. The technique may continue during the development process to address dynamic changes in requirements and technical capabilities.

Type A, B, C, D, E Specifications. See functional, allocated, and product baselines.

—Design Reviews & Audits

System Requirements Review (SRR). A formal review to ensure that system requirements have been completely and properly identified and that there is a mutual understanding between the government and contractor.

System Design Review (SDR). A formal review of the conceptual design of the system to establish its capability to satisfy requirements.

Software Specification Review (SSR). A formal review of software configuration items (CSCI) requirements and operational concept.

Preliminary Design Review (PDR). A formal review which confirms that the preliminary design logically follows the SDR findings and meets the requirements, and results in approval to begin detail design.

Critical Design Review (CDR). A formal review to evaluate the completeness of the design and interfaces.

Functional Configuration Audit (FCA). A formal review which verifies that the actual item which represents the production configuration complies with the development specification.

Test Readiness Review (TRR). A formal software review on each CSCI to determine if software test procedures are complete and if the developer is prepared for formal software testing.

Physical Configuration Audit (PCA). A formal review which establishes the product baseline as reflected in an early production configuration item.

Formal Qualification Review (FQR). A systems level configuration audit conducted after system testing is completed (to ensure performance requirements of the system specification have been met).

Engineering Change Reviews. Assessments of the impact of engineering or design changes.

Configuration Management Baselines

Functional Baseline. (type A system specification) provides the basis for contracting and controlling the system design.

Allocated Baseline (type B development specification). Defines the performance requirements for each configuration item of the system.

Product Baseline (type C product specification). Established by the detailed design documentation for each configuration item. Normally includes Process Baseline (type D specification) and Material Baseline (type E specification).

Software Engineering

Software Policy Decisions. DOD Directives 5000.29, 3405.1 and 3405.2 reflect current DOD policies.

High Order Language (HOL). Ada, is the preferred standard HOL for mission critical computer resources.

Software Development Plan (SDP). A management plan usually generated by the developer that covers the software development effort.

Computer Resources Life Cycle Management Plan (CRLCMP). Life-cycle management plan developed by program managers and their management team.

Independent Verification and Validation (IV&V). An independent review of the software product for functional effectiveness and technical sufficiency.

Software Quality Assurance (SQA). The process of assuring that a software product is produced which performs properly, has minimum support requirements, and facilitates maintenance as specified.

Software System Requirements Definition. The analysis of user requirements to produce functional requirements for software at the A-specification level.

Software Requirements Analysis and Allocation. The decomposition of the A-specification requirements into functional requirements that are allocated to software at the B - specification level.

Computer Software Configuration Item (CSCI). The software element designated by the procuring agency for configuration management.

Software Design. The designing of the software systems to meet the functional requirements allocated in the B-5 specification.

Software Coding. The coding (programming) of the software in accordance with the software design.

Software Test and Debug. The testing of the software to the functional requirements presented in the B-5 specification.

System Integration and Testing. Integration of software and hardware, and testing against A and B—specification requirements.

Produce and Issue Software. Place or install software on appropriate medium (such as tape, disks, cartridge) for delivery and operational use.

Post-Deployment Software Support. The post-development process of updating software to fix errors, improve performance, meet new requirements or operate in new hardware.

COST

Life-Cycle Cost (LCC). The total cost to the government for acquisition and ownership of the system over its full life.

Design to Cost (DTC). An acquisition management technique to achieve weapon system designs that meet stated cost requirements.

Test and Evaluation (T&E)

Test and Evaluation Master Plan (TEMP). The top-level, summary test management document covering all phases of testing. Subsequent to its initial issue, the TEMP is updated at each major milestone or at any time there is a significant change to the test program.

Test Results/Reports. The conduct of testing and the associated collection reduction and analysis of test data continues throughout the acquisition life cycle. The issuance of formal test reports is typically aligned with the major milestones to provide the essential risk reduction information and to support the program decisions.

Development Test and Evaluation, (DT&E). Conducted to assist the engineering design and development process, to define and delineate technical progress, and to verify attainment of specified technical performance. DT&E is the responsibility of the material developer.

Operational Test and Evaluation, (OT&E). Conducted by the component's independent assessor to estimate a system's operational effectiveness and suitability, to identify needed modification, and provide information on tactics, doctrine, organization, and personnel requirements. OT&E can be subdivided into two phases not shown on the chart.

Initial Operational Test & Evaluation (IOT&E). Conducted before the production decision to provide a credible estimate for operational effectiveness and suitability of a system as close to a production configuration as possible, in an operationally realistic environment, by typical user personnel.

Follow on Test & Evaluation (FOT&E). Conducted on the deployed system to determine if operational effectiveness and suitability is, in fact, being attained.

OT&E Certification. The report to the secretary of defense and to the committees on armed services and on appropriation of both the House and the Senate which permits a major defense acquisition program to proceed beyond low-rate initial production. The report covers the adequacy of the T&E performed and whether the effectiveness and combat suitability of the items are confirmed by the actual task.

Production Acceptance Test and Evaluation (PAT&E). PAT&E is conducted on production items to demonstrate that those items meet the requirements and specifications of the procuring contracts or agreements. PAT&E is the responsibility of the material developing agency; however, the cognizant plant representative is usually tasked to support this effort.

Modification Testing. Modification testing is conducted during the deployment and operational and support phases of the acquisition cycle on those items undergoing modification. Major emphasis is upon testing of the interface between the old and new, as well as logistics supportability.

Manufacturing.

Evaluate Production Feasibility. Assess the likelihood that a system design concept can be produced using existing manufacturing technology.

Assess Production Risks. Estimate probabilities of success or failure in manufacturing.

Evaluate Manufacturing Technology. (MANTECH) needs discriminate manufacturing capabilities versus requirements to define new facilities and equipment needs.

Estimate Manufacturing Costs. Develop resource estimates for manufacturing of various systems alternatives.

Design to Goals. Desirable design parameters for the system.

Acquisition/Manufacturing Strategy. The approach to obtaining the total quantity of a system at some rate for some cost.

Resolve Production Risk. Demonstrate required advances beyond the current capability.

Complete Manufacturing Technology Development. Manufacturing technology is developed through a phased approach from definition to demonstration. This represents the final demonstration of the integrated manufacturing scheme.

Preliminary Manufacturing Plan. The description of a method for employing the facilities, tooling and personnel resources to produce the design.

Preliminary Producibility, Engineering, and Planning (PEP). Initial application of design and analysis techniques to reduce the potential manufacturing burden.

Industrial Base Issues. Critical resources, skills and long lead materials and processes which are required by the system design.

Preplanned Product Improvement (P^3I). See Systems Engineering.

Final Manufacturing Plan. The refined and formalized initial manufacturing plan.

Execute PEP. Incorporate the producibility analysis into the mainstream of design effort.

QA Plan. A plan to ensure conformance to requirements which includes quality of design and quality of conformance.

Low Rate Initial Production (LRIP). Low rate of output used to prove manufacturing technology and facilities at the beginning of production.

Production Readiness Review (PRR). Formal examination of a program to determine if the design of the product and the manufacturing process are ready for the production phase.

Contractor Surveillance. Verification of conformance to plans during production. Surveillance may be conducted by on-site government representatives, authorized specialists, the program office or a combination.

Incorporate GFP/GFE. Execution of contracts and management of items provided as government furnished property/government furnished equipment (GFP/GFE) to the contractor.

Value Engineering (VE). A program to allow for the sharing of cost savings derived from improvements in the manufacturing processes.

Second Source. Execution of acquisition strategy to establish two producers for the part or system.

Breakout. Execution of acquisition strategy to convert some parts or systems from contractor furnished to government furnished.

Production of Spare Parts. Arrange for purchase of spare parts or a portion of normal production runs (see - ILS (Integrated Logistic Support) Post Production Support).

Production of PIP Mods. Manufacture of items which incorporate results of activities like product improvement program (PIP), P^3I, and product modifications.

Integrated Logistics Support (ILS)

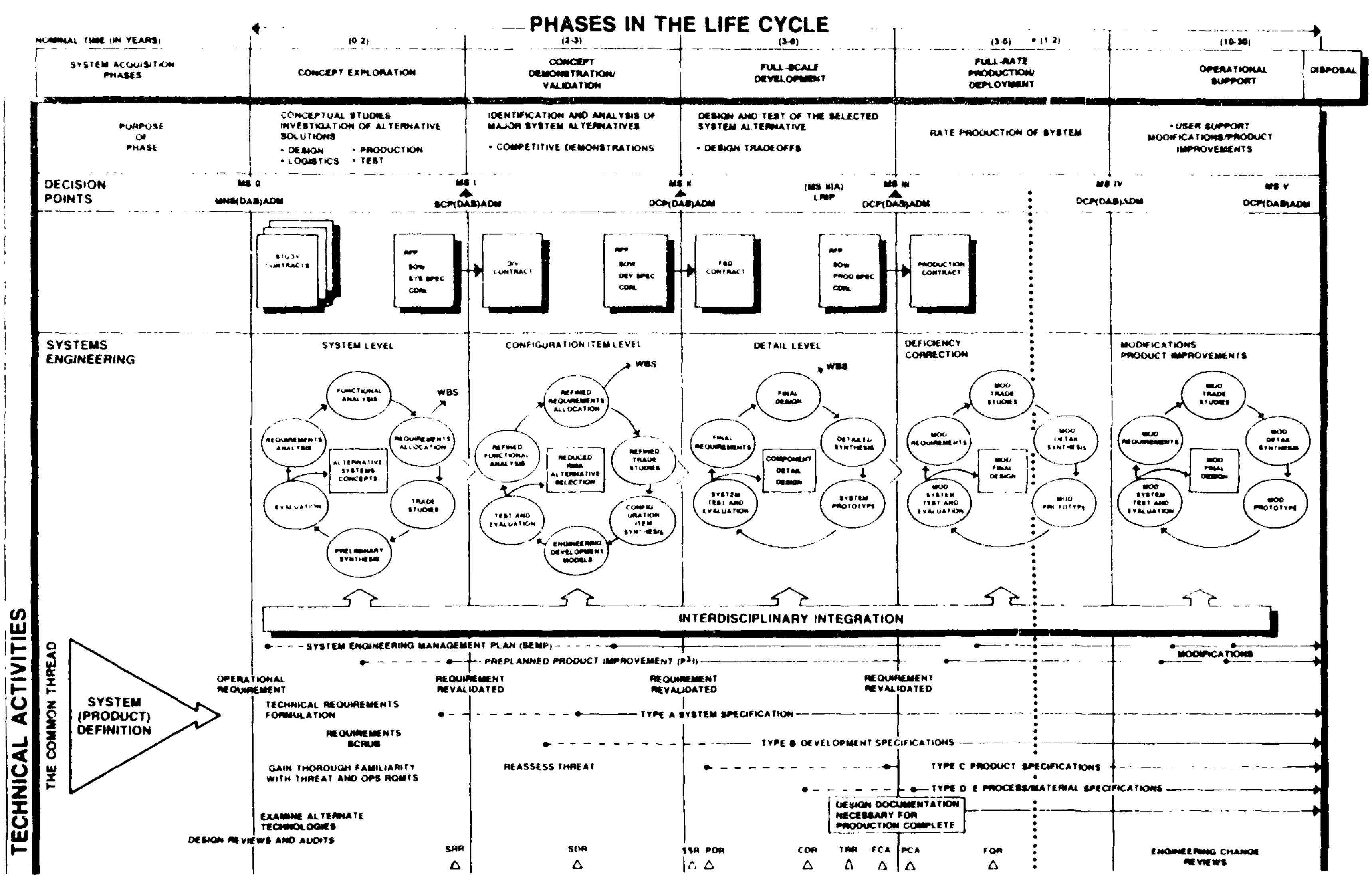
Develop ILS Strategy. Logistics acquisition strategy is developed setting forth objectives, resources, management assumptions, extent of competition, proposed contractural vehicles & program structure, but with emphasis on maintenance approach, operational support patterns, constraints, contractor role, GFE, transition, warranties and post-production support.

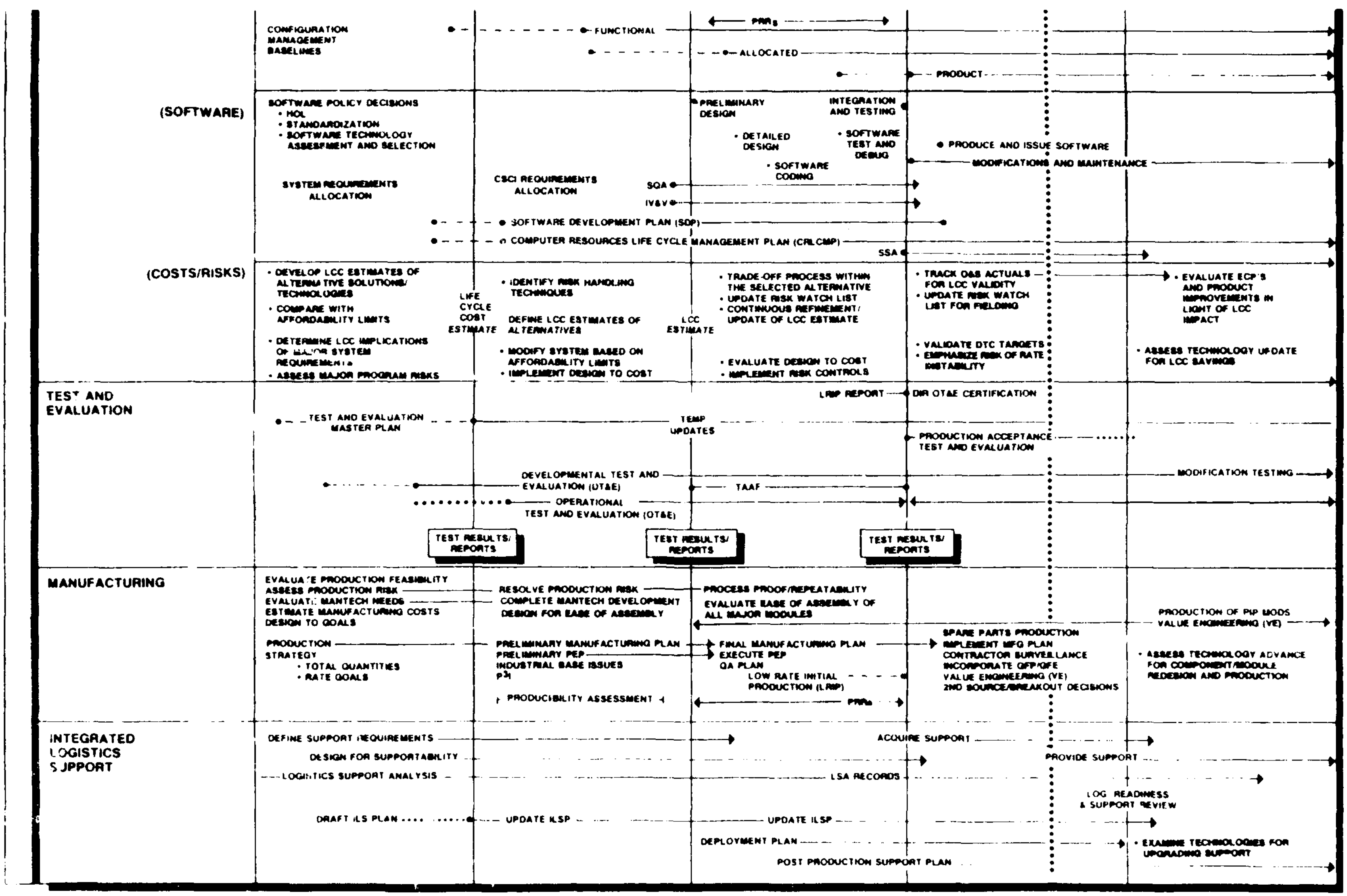
ILS Alternatives/Trade-Offs Assessments/Support Cost Studies. Largely consists of data gathering and modeling. Data comes from "Lessons Learned" files, comparative analyses, technological opportunities, use studies, field visits, standardization requirements, functional and military requirements, constraints, maintenance and operational approaches. Analyses and assessments are made on the cost and effectiveness of alternative support methodologies and supporting identified alternatives.

Draft Integrated Logistics Support Plan (ILSP). The early logistics plan dealing with organizational authorities and responsibilities and containing broad logistics strategy, goals/thresholds, and maintenance concepts. Can also be referred to as a preliminary ILSP or ILS Management Plan (ILSMP)

Integrated Logistics Support Plan (ILSP). The formal planning document for logistics support. It is kept current through the program life. It sets forth the plan for operational support, provides a detailed ILS program to fit with the overall program, provides decision-making bodies with necessary ILS information to make sound decisions in system development and production and provides the basis for ILS procurement packages-specifications RFPs, SOWs, source selection evaluation terms and conditions, CDRLs.

Figure 1. SYSTEM LIFE CYCLE TECHNICAL ACTIVITIES





ALL INQUIRIES AND COMMENTS ON THIS CHART SHOULD BE ADDRESSED TO THE TECHNICAL MANAGEMENT DEPARTMENT, DEFENSE SYSTEMS MANAGEMENT COLLEGE, FORT BELVOIR, VIRGINIA 22060-5426

DSMC CHART SE T 1001
REVISED FEB 1988

Logistics Support Analysis (LSA). A formal tool under MIL-STD-1388-2 that helps identify and trade off qualitative and quantitative logistics support requirements. It is a logical, documented basis from which to influence design and force a degree of requirements integration. It also provides a yardstick from which to assess logistics objective achievement.

Logistics Support Analysis Record (LSAR). That portion of LSA documentation consisting of detailed data pertaining to the identification of logistic support resource requirements of a system/equipment. See MIL-STD-1388-2 for LSAR data element definitions.

Material Fielding Plan (MFP). The plan to ensure smooth introduction of the system/equipment to the user.

Post-Production Support. Systems management and support activities necessary to ensure continued attainment of system readiness objectives with economical logistic support after cessation of production of the end item (weapon system or equipment).

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 4.2
Version: Update
Date: December 1988

I. TITLE

Preplanned Product Improvement (P^3I)

II. REFERENCES

—DODI 7041.3, Economic Analysis and Program Evaluation of Resource Management, Oct 1972

—Carlucci, Frank C., Deputy Secretary of Defense Memorandum, "Improving the Acquisition Process Through Preplanned Product Improvements," (This memo contains the DOD Implementation Plan) 6 July 1981

—Miller, Phillip E., "Evolutionary Development and Acquisition of Weapons Systems," Ph.D. Dissertation, Defense Systems Management College (DSMC) Library, Fort Belvoir, VA

—*Systems Engineering Management Guide*, DSMC

—*Acquisition Strategy Guide*, DSMC

—*Manufacturing Management Handbook*, DSMC

—AMC-TRADOC Material Acquisition Handbook Pamphlet 70-2

—Defense Acquisition Circular 76-43

—NAVMAT Pamphlet, P-9494, "Navy Program Manager's Guide

III. POINTS OF CONTACT

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IV. PURPOSE AND SCOPE

This fact sheet is designed to:

—Provide a definition and description of P^3I

—Outline the objectives of P^3I

—Describe basic guidelines for the implementation of P^3I.

V. POLICY

The DOD policy, resulting from the DOD Acquisition Improvement Program initiated in 1981, states that principles of P^3I shall be considered in planning major system acquisition. Policy encourages program managers to consider P^3I in the development of the program acquisition strategy when it is clearly established that its application will reduce program risk, and speed delivery of a near-term creditable system designed for future improvements. P^3I should not be used to artificially extend the development effort or correct deficiencies discovered in the development/testing process.

Objectives of P^3I include:

1) Introduction of higher technological performance during system lifetime through more rapid fielding of technological advances.

2) Shortening of acquisition and deployment times.

3)Reduction in system technical, cost and schedule risk.

4) Extension of system useful life (preventing early obsolescence).

5) Reduction of requirements for major system new starts.

6) Improvement of system operational readiness during lifetime.

VI. DEFINITION OF P^3I

The P^3I is an acquisition concept which programs resources to accomplish the orderly and cost effective phased growth or evolution of a system's capability, utility and operational readiness. Specifically, P^3I is a strategy which defers technologically difficult system requirements in favor of a near-term system containing design considerations to facilitate future upgrades. The deferred requirements are developed in parallel with the basic system and continue past its production decision.

The P^3I should be distinguished from standard product improvement which is a separate (new money) effort to develop and apply improvements that were not anticipated during the development of the basic system

The P^3I concept includes three distinct phases which begin in concept exploration and continue throughout the life cycle of the system. Figure 1 provides a brief definition of each phase and shows the interaction of P^3I with the system acquisition process. The *P^3I cannot be undertaken unless the system requirements document specifically outlines the required growth area and the time frame the upgrade is required.* For example, the need statement for a new artillery piece would read: "30 kilometers of range required at IOC, 45 kilometers required NLT 6 years after IOC, and 60 kilometers required NLT 2005." This allows the program manager to develop and produce the basic system while pursuing the technology required for both increments of improvement in parallel with the basic system. This means that RDT&E appropriations will continue to flow to the program to support the development of the incremental upgrades. Following application of the first improvement, a third upgrade may be envisioned because 6 years of technology and threat changes have come to pass. The system requirement document is amended and parallel development for this upgrade is started. Thus, P^3I seeks to proactively develop system improvements and thereby extend the system's useful life and reduce the need for replacement systems.

VII. APPLICATION CRITERIA

The P^3I concept cannot be applied to all new system developments but can be applied, and should be considered, under the following conditions:

1) There is a long-term military requirement to be satisfied.

2) The threat or need is projected to change as a function of time requiring a change in the response.

3) System performance requirements are expected to increase over time.

4) A near-term basic system is necessary and acceptable.

5) The sponsoring service is willing to pay the higher initial costs to obtain growth potential for future exploitation.

It must be noted that, when P^3I is incorporated, the need for future modification of the system must be recognized early in program development, and the acquisition strategy must include parallel development of deferred performance improvements. This clearly implies the continuance of RDT&E funding past the production and fielding of the basic system. Under the P^3I concept, RDT&E funds must continue to flow to the Program Office for as long as the evolutionary development strategy is pursued. For the Air Force, this also implies the elimination of the old concept of Program Management Responsibility Transfer (PMRT). In the larger context, it implies that program offices will dissolve only when a system has been identified for disposal and all improvements programs are halted.

An effective P^3I strategy should include:

—Modular designs

—A carefully designed architectural interface system.

—Provisions for growth beyond those associated with good engineering principles keyed to known growth requirements and designed to facilitate both production cut-in and retrofit of already

Figure 1. PERTINENT TOPICS TO CONSIDER FOR THE IMPLEMENTATION OF P³I

Pertinent topics to consider for the implementation of P³I include:

Phase	Time Frame	Topics
I	Commences in Concept Exploration/ Definition, goes through life cycle	• Compare potential to projected need • Analyze evolutionary needs • Modification potential • Integrated logistics support • Cost • Time • Technology • Threat • Funding • User input • Budgeting • Life-cycle costs • Program risks • Block improvements
II	Commences in Concept Demonstration/Validation, goes through life cycle	• Impact on other systems • Engineering change proposal • Production improvement • Integrated logistics support • Potential savings to other systems • Commercial items with concurrent R&D • Cost • Time • Funding • Potential savings • Risk reduction • Life-Cycle costs • Producibility • Survivability
III	Commences in Full-Scale Development, goes through life-cycle	• Additional Phase II applications • Engineering change proposals • Production improvement • Integrated logistics support • Cost • Funding • Savings • Survivability • Producibility

fielded systems. Growth areas include; but are not limited to, provisions for space, weight changes, cooling capacity, power requirements, electrical connections, computer processing capacity, and interface with other systems.

VIII. IMPLEMENTATION OF P³I

The decision to use P³I should be made as early in development as possible, but can be made even after a system has been produced, as long as the proper conditions exist and a major improvement has been identified along with service support to begin the proactive upgrade process.

The following steps should be considered for the implementation of P³I:

1) Perform applicable threat and technology assessments to identify the need for and potential effectiveness of P³I.

2) Include P³I as a specific element of the program acquisition strategy and budget appropriate time, funds and contractor support. (Funds must be set aside to develop the higher technology; and these funds must not be used to fund cost growth in the basic program).

3) In the acquisition strategy, ensure that logistics supportability will be maintained for the basic

system during P^3I modification and after all improvements are implemented. In addition, develop P^3I for the support system as well.

4) To facilitate implementation, develop a plan to translate system growth requirements into initial design strategy. The basic system must be designed up-front with P^3I in mind. Retrofit/modification costs will be inversely proportional to the amount of early design of the system to incorporate the P^3I at some later date.

5) Develop a set of system requirement documents which show the evolutionary technical developments to be incorporated. Also include an orderly, time-phased integration of enhanced system capabilities.

6) As program acquisition/development proceed, develop strategy and plans to develop, contract, schedule, budget and integrate P^3I modifications. Resource requirements must be identified in the planning, programming, budgeting system cycle and placed in the appropriate documents.

7) Establish and maintain a highly disciplined configuration management system. Strict configuration control must be applied to subsystem boundaries, space, weight, power, cooling movement, centers of gravity, electromagnetic emissions, the logistics support system, etc. Adequate communication channels should be established to ensure feedback of modification data to maintain current configuration status accounting.

8) Communicate the P^3I acquisition strategy to industry early-on in the program and include industry in the process of developing the strategy. The initial request for proposal should specify platform capacity or other characteristics not needed in the system now but anticipated for later use. Design flexibility to incorporate change might be used as an evaluation criteria element. Proposal evaluation criteria for both Concept Demonstration/Validation and Full-Scale Development should relate to the offerors ability to propose and conduct a P^3I program.

9) Once established, maintain the P^3I plan. Input for the plan is received from DOD and industry, laboratories, prime contractors, subcontractors and others as new technology and other opportunities are perceived for system improvement. As technology advances and the threat changes, this plan should be updated to maintain currency.

10) Prepare and maintain a system modification plan. The initial step in implementing an improvement modification is the preparation of a modification plan. Essential elements of the plan should include:

—Purpose of the modification; impact on system effectiveness

—Description of modification; power, weight, volume, data interface

—Identification of items to be modified; type, location, configuration status, availability

—Strategy for implementation; schedule, modification, phasing

—Organizational responsibilities; lines of communications, configuration management, data generation

—Logistics support; packaging and handling and transportation, training, manuals, and supplies.

11) Ensure that the test and evaluation strategy includes approaches that maintain the viability of P^3I through the development and production acquisition phases. Prototype P^3I systems may require production systems as test beds. Plan in a feedback system so that changes to the basic system made as a result of testing, which affect the P^3I design, are provided to the P^3I designers in a timely manner.

12) Design the baseline so that it is capable of accepting the P^3I modification. Production strategy should ensure that proper tooling and test equipment will be available for modification; the deployment strategy should include the approach for phasing in the updates.

IX. SUMMARY

The P^3I provides the flexibility to incorporate advancements to a baseline system without violently disrupting the original design. The modular design afforded by P^3I permits growth to meet the changing threat and allows the incorporation of significant technological or operational opportunities at appropriate time intervals. The baseline technological risk will be minimized and lead to earlier system deployment with reduced unit costs and less likely cost overruns.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number 4.3
Version: Update
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I. TITLE

The Systems Engineering Management Plan

II. REFERENCES

—MIL-STD 499A, "Engineering Management"

—Data Item Description S-3618, "The Systems Engineering Management Plan"

—*Systems Engineering Management Guide*, Chapters 1, 3

III. POINTS OF CONTACT

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IV. PURPOSE AND SCOPE

This fact sheet is designed to:
—Describe the content and function of the Systems Engineering Management Plan (SEMP).
—Facilitate the cost-effective use of a SEMP in the planning and execution of each weapons systems development program.
—Be general in application (e.g., service unique policies and practices conform to these general guidelines).

V. POLICY

It is the policy of the Department of Defense that "a SEMP be prepared by each development/acquisition agency directed to accomplish systems engineering as a part of a development project, and by each contractor whose statement of work calls for systems engineering." (MIL-STD-499A)

VI. DEFINITIONS

—Systems Engineering (SE): "The application of scientific and engineering efforts to: (1) transform an operational need into a description of a system configuration which best satisfies the operational need according to the measures of effectiveness; (2) integrate related technical parameters and assure compatibility of all physical, functional, and technical program interfaces in a manner which optimizes the total system definition and design; (3) integrate the efforts of all

engineering disciplines and specialties into the total engineering effort."

—**Systems Engineering Process**: The iterative logical sequence of analysis, design, test and decision activities that transforms an operational need into the descriptions required for production and fielding of all operational and support system elements.

—**Systems Engineering Management**: The management function that controls the whole design process for the purpose of achieving an optimum balance of all system elements, *rather than* the optimization of individual elements *or* optimization of the system with respect to only a limited set of "design-for" criteria.

VII. THE SEMP ROLE

A SEMP is prepared by each development contractor (and government development agency) for program manager (PM) approval. It is the only top-level management plan covering the nature, timing, and integration of all technical development activities. The SEMP provides the only complete source of PM visibility into the organization, direction, control mechanisms, and personnel to be used throughout development to satisfy cost, performance, readiness, and schedule objectives. The WHO, WHAT, WHEN, WHERE, HOW, and WHY of the development, evaluation, and decision-making processes must be clearly explained.

Prior to 1966, DOD practiced a very rigid, cookbook approach to SE. There was little incentive to customize the process to the management of a particular acquisition and the result was often an excessive amount of detailed documentation which was difficult to manage, time-consuming to read, and not effectively used by either the engineers or managers for whom it was intended.

The MIL-STD-499A, "Engineering Management," is intended to eliminate this deficiency. The SEMP that this standard concerns does the following:

—Explains "WHAT to do," not "HOW to do it."

—Permits contractors to select and use, following government approval, the SE process they believe will best suit the project.

—Minimizes required documentation by:

—Implementing a series of technical reviews and audits.

—Allowing use of the contractor's internal documentation.

—Specifically identifying the deliverable documents for each program, by phase.

When completed (not later than the start of full scale engineering), the SEMP defines and fully describes the type and extent of the SE and the SE management processes which will be used for a particular development program. It explains how the required specialized engineering disciplines will be identified and integrated. The plan is also the means by which the program manager implements special management activities needed to achieve program objectives; i.e., risk analysis, formal configuration management, resource allocation by design-to-cost methods, work element analysis, mandatory trade-off study decision criteria, producibility enhancement and value engineering planning, design quality standards, and affordability rules, etc.

To be a worthwhile top management tool, the SEMP must explain the relationship of the intended SE management system, organization, and SE process to each engineering organization. The SEMP must treat these engineering organizations as elements of a consciously integrated development plan rather than serve only as a composite or summary of discrete subplans, each covering a single disciplinary concern. It must also contain unequivocal identification of organizational responsibilities and of authority for SE management decisions. It must specify the control methods that will be used, the procedures that will ensure integration of requirements and constraints, and the schedules by which every essential technical program document and review will be generated, approved, and executed. This content must be clearly organized in a format with management utility.

VIII. FORMAT AND CONTENT

A format of the SEMP is defined in Data Item Description (DID) S-3618. The three standard segments of a SEMP address technical program planning and control, the SE process, and methods for engineering specialty integration.

Part I

Technical Program Planning and Control. This portion identifies organizational duties and assigns authority to individuals with SE management responsibilities. It specifies:

—Who is responsible for control of subcontracted engineering
—Responsibility for establishing performance and design requirements
—Control methods (review boards, working groups, document routing, etc.) for work planning and progress tracking
—Technical program quality assurance methods
—Responsibility and schedules for documentation generation, approval, and release
—Schedules for technical reviews, agenda preparation/approval responsibility, and follow-up action tracking methods
—The configuration management and standardization strategies to be followed.

Part II

Systems Engineering Process. The process to be used by THIS contractor on THIS project is laid out in complete detail, including:
—Implementation procedures and schedules
—In-house documentation
—Trade-study methodology
—The types or identities of the mathematical and simulation models to be used in defining system requirements, optimizing system configuration, and performance prediction and verification
—The time phased configuration management plan
—The specification generation/selection process.

The operational SE process tasks (functional analysis, synthesis, trade-off, etc.) will be defined and their applicability and intended execution sequence at each level of design will be specified. The contractor will explain in this section the intended strategy for the generation of multiple alternate designs at each development level, and the trade-off results that will trigger iteration of the design process.

Part III

Engineering Specialty Integration. The detailed program plans for each engineering specialty will be summarized or referenced. The schedules, organizational responsibilities, and procedural methods by which the integration of these efforts is to be accomplished will be specified. This section shows how each specialty discipline fits into the systems engineering process as it is executed at each level of design and the extent to which its actions will be controlled by the SE organization. Where the specialty programs will overlap within the design of system components, careful explanation of the responsibilities and authorities assigned to each organization must be included.

The specialty plans to be integrated by SE *may* include those for:
—Producibility
—Reliability
—Maintainability
—Quality
—Human Engineering
—Safety
—Logistics Support Analysis
—Contamination and Corrosion Control
—Parts, Materials, and Processes Control
—Electromagnetic Control
—Nuclear Hardening
—Vulnerability/Survivability
—Mass Properties Control
—Packaging, Handling, Storage, and Transportation.

This is not a checklist. Not all of these are required on every program, nor are all of those required by a particular program manager listed. Where separate plans are not prepared as deliverables or contractor in-house documents, the SEMP must contain a summary of the tasks required of those engineering specialties. These summaries must reference the appropriate elements of the contract work breakdown structure. Whether prepared as separate plans or included as sections of the SEMP, each of these plans should contain the following elements:
—*Objective*: Purpose for which included and scope of responsibility.

—*Activity Definition*: Summary description of all tasks required to fulfill the specified function, content of required inputs, and the expected outputs.
—*Responsibilities*: Identification of all organizations supporting (or supported by) the activity, which tasks they are responsible for, and their lines of authority.

—*Schedules*: Timing and sequence of all engineering tasks related to major milestones for system development and design, and to specific support organization inputs.

—*Resource Definition*: Identification of specific hardware, software, personnel, and facilities required to complete the engineering tasks according to the schedule.

The available level of detail varies with time, discipline, and project. However, the PM will significantly enhance the value of the SEMP and the SE effort in general by insisting that the greatest possible level of planning detail be included in these statements of intent.

IX. TIMING

The contractor SE team is providing the government PM with concept studies and requirements definitions during the concept exploration/definition (CE/D) phase. This team must be expanded to be ready to accept program control, software design management, support matrix control, and all other SE duties when the SEMP is implemented.

The MIL-STD-499A requires that an approved SEMP *be implemented with the award of the first full-scale* development contract. However, some of the most critical SE activity will have been completed before that time and a program manager cannot reasonably wait until that point to gain visibility into the contractors' SE methods. Instead:

1. As part of the CE/D phase source selection process, the government must review the record of each offerer relative to past SE actions, and must evaluate the offerer's plan for control and execution of CE/D phase SE tasks.

2. The PM should include in the CE/D phase statement of work (SOW) a task described as the generation of "a program SE management plan." This plan should be an end-of-phase deliverable. The government PM can make this a cost-effective effort, keeping the cost VERY low (1% of the CE/D phase contract value—MAX), *by carefully wording* the description of this document to assure that it will be appropriately general in scope and will contain only essential details regarding timing and approval of major technical management documentation. Specification of a page-number limit should be considered. The PM should recognize that each contractor must have an internal-use SEMP in order to execute the staffing, organization, and analysis tasks that will have to begin immediately upon concept demonstration/validation contract award. Therefore, requiring its delivery for government review will NOT ADD significantly to the CE/D phase effort.

3. The CD/V contract must specifically require not only control of the CD/V phase SE activities in accordance with the management plan provided in the winning proposals, but must require expansion of that plan into a formal MIL-STD format SEMP. Depending on the planned duration of the program's CD/V phase, several options must be considered by the PM in composing the Data Item Description (DID) that will detail the timing of SEMP delivery and implementation. If preliminary detailed allocation of subsystem and component functions must take place during CD/V to permit prototype fabrication and testing, the PM should have approved the contractor's SEMP before this activity begins. This prototyping activity is design, however preliminary, and must be under the effective control of the government/contractor SE management team if there is to be a realistic expectation that the full-scale engineering development of the designs validated during this phase will be able to produce an optimized, producible, and supportable operational system.

While no policy or regulation *requires* this approval of contractor(s) SE management plan(s) prior to prototype design, and while some contractors *may consider such a requirement "unnecessary"* government involvement, the contractor design team *has* a plan (since without one, the complex design task could not be completed) and providing it to the PM for review does not add a new document development task to the CD/V effort. Therefore, when the CD/V phase will include major or potentially permanent design efforts, the SEMP should be delivered, reviewed, revised, approved by the PM, and implemented through CD/V phase contract modification or option execution, before this design activity begins.

Recognizing that a MIL-STD format SEMP (DI-S-3618) will usually be required in FSD proposals, requiring delivery in that format during CD/V may result in savings on total administrative effort. The PM should, however, seek the advice of each contractor on the format that will most efficiently meet program needs prior to FSD.

If not contractually implemented during the CD/V phase the SEMP must be submitted as a part of each contractor's full-scale development proposal.

reviewed as a part of the source-selection process, modified as required during negotiations following contractor selection, and become contractually binding at the earliest possibie date (positively not more than 60 days after contract award).

The SEMP being used during any phase should include its own update plan specifying which sections must be kept current, who will submit and review changes, and on what dates or in association with what program milestones the updated editions will become effective.

X. COST EFFECTIVE UTILIZATION

1. Each interested contractor can, and should, be required to include some form of a SEMP (explaining how the bidder plans to manage SE tasks both during CD/V and following phases) in the CD/V phase proposal. As a result, some PMs have elected not to pay for generation of this plan as a CE/D deliverable. However, the SEMP will be most cost effective when it is *both* CE/D contract data requirements list (CDRL) item *and* is identified in the CD/V phase request for proposals (RFPs) as a major factor in source selection.

2. The format of MIL-STD—499A was designed to assure that an effective tailoring effort will be completed by the PM before it is used on any design program. The standard contains only the most general description of the intent of SE management. All detailed contractor tasks, except preparation of the SEMP to levels of detail appropriate to the program phase, are contained in optional appendicies which must be specifically identified by the PM for contract inclusion in the RFP. As a part of the job of selecting which SE tasks to include, the PM must require specific revision, editing, and modification of the MIL-STD 499A wording relative to the required content and format of the SEMP. This SEMP tailoring effort must be repeated every time a new RFP is originated or an existing contract is renegotiated. Circulation of draft RFPs enables the PM to acquire contractor comments on the cost and effectiveness impacts of proposed SEMP requirements before they become part of the formal contracting process.

3. The document delivered during CE/D and that included in the contractor's CD/V proposal may not be identical. They need not be called "A SEMP," or formatted to fit DI-S-3618 given their preliminary nature and limited depth. The title and format are not significant provided the intended purpose of the planning document is clearly described in the CD/V phase RFP.

4. Some portions of the SEMP are not appropriate for inclusion in the development contracts. Each RFP must require that the offerer identify in the proposal which portions of the SEMP are proposed for specific contractual inclusion. Non-contractual items will normally include the details of the engineering organization structure, the assignment of personnel to SE management positions, and other items dynamic enough to prevent their being cost-effective kept continually current through formal contract change control.

5. The SEMP included with a contractor's proposal may not be sufficient to allow complete evaluation of SE management capability. Each RFP should require that, upon request of the procuring activity, the contractor make available all internal information on engineering management procedures and activities. The source selection team must be aware that this information is available for use in evaluating the offeror's capability to satisfy the SE requirements of MIL-STD 499A and the ability to execute the actions outlined in the SEMP.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 4.4
Version: Update
Date: December 1988

I. TITLE

Logistics Support Analysis/Logistics Support Analysis Record (LSA/LSAR) Process

II. REFERENCES

—DODD 5000.39, "Acquisition and Management of Integrated Logistic Support for System and Equipment"

—MIL-STD-1388-1A, "Logistics Support Analysis"

—MIL-STD-1388-2A, "Logistics Support Analysis Record"

—AFSCR 800-24/DARCOM 700-97/NAVMATINST 4000.38/MCO P 4110.1A, May 27, 1977, "Standard Integrated Support Management System"

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IV. PURPOSE AND SCOPE

This fact sheet is designed to:

—Describe the LSA process, goals, products, and management practices

—Be general in scope; i.e., since Service unique practices and procedures are not stressed herein.

—Describe implementation considerations.

V. POLICY

It is the policy of the Department of Defense that LSA be used throughout the acquisition cycle to assess and alter system design and to establish and update support element requirements. The MIL-STD-1388-1A shall be tailored appropriately and applied in each acquisition program. The LSA documentation shall be maintained to serve as the definitive source of data for ILS resource requirements determinations.

VI. DEFINITION

The LSA process is a systematic and comprehensive analysis conducted on an iterative basis through all phases of the system/equipment life cycle to satisfy supportability objectives. The selection, level of detail, and timing of the analyses shall be tailored to each system/equipment amd shall be responsive to program schedule and milestones. The LSAR is a standardized medium for systematically recording, processing, storing, and reporting data generated by some of the LSA tasks during the ILS program.

VII. PROCESS

The contractor's LSA tasks are initiated as part of the preproposal effort in preparation for a com-

petitive proposal. A close working arrangement is usually established among various competing contractors and government program and logistic management specialists during the conceptual phase. The contractor's competitive proposal will respond to the specific and tailored RFP requirements for LSA and will identify the planned approach and the key issues will be addressed. Therefore, the burden is on the government to describe accurately what it wants and to understand the time and work load requirements it has generated.

Following contract award, the contractor and the government logistic management specialists will pursue the LSA tasks on a joint-effort basis. The analytical tasks started during the conceptual phases will be iterated and will progressively increase in depth and scope as the program moves into successive phases.

The validity of the analysis and the attendant data products must be successfully demonstrated. Results of formal test and evaluation program and postdeployment assessments are analyzed by the contractor and the government, and corrective actions implemented as necessary. The process of testing, evaluating, and correcting deficiencies in the design and the support system continue throughout the life cycle.

The government ILS manager's oversight of the contractor's LSA role involves the following tasks:

—Program guidance
—Assessment of compliance with contractual requirements
—Provide models and input parameters (e.g., LCC, stockage levels, readiness, and level of repair)
—Conduct periodic reviews
—Provide government data and/or factors for use studies
—Provide the government-deployed Joint Services LSAR ADP System, or approve an alternative contractor proposed program.

The LSA process is a planned series of tasks performed to examine all elements of a material system to help determine the logistic support required to make and keep that system usable for its intended purpose. The LSA process also structured to influence the design so that both the system and its support can be provided at an affordable cost.

The LSA planned series of tasks can be grouped into three general categories: (a) those that *analyze* and *synthesize* the logistic support requirements, (b) those that *verify* (test and correct) the adequacy of the logistic support identified and (c) those that are required to *manage* the total process.

Government management of the LSA process begins in the preconcept phase before the program is formally initiated. Developing or planning a strategy for the LSA is the first task to be performed.

Logistic analytical tasks begin during the concept exploration definition phase and may be iterated in conjunction with the potential performing activity (competing contractors) tasks throughout the concept demonstration and validation and full-scale development phases, and into the production phase as ECP and P³I type design changes are made. These initial tasks are performed to (a) influence design and operational concepts; (b) estimate gross logistics requirements of alternate concepts; and (c) relate design, operation and support characteristics to system readiness objectives. The results of the early analytical tasks are (a) definition of system/equipment hardware, software and support concepts; (b) evaluation of alternative tradeoffs; and (c) identification of resource requirements. The government's verification tasks begin early in the process using simulation models and baseline comparison systems. Verification tasks continue in conjunction with the contractor throughout the life cycle. It is essential for the government ILS manager, in conjunction with other acquisition program specialists, to conduct LSA early in the program life cycle to identify constraints, thresholds, and targets for improvement. These early tasks also provide supportability inputs into early system engineering trade-offs.

LSA Task Requirement. The LSA requirements are detailed in MIL-STD-1388-1A and consist of five (5) general task sections involving 15 tasks and 77 subtasks. The government ILS manager must become familiar with each task and its purpose, use, and expected results. The following paragraphs summarize the five (5) tasks sections and identify the tasks; the MIL STD should be consulted for details. The time phasing and interactions of the individual tasks are provided in Figure 1.

Figure 1. ACQUISITION PHASE TIMING OF LSA TASKS

LSA TASK SECTIONS AND TASKS	PRE-CONCEPT	EVALUATION	D/VAL	FSD	PRODUCTION DEPLOYMENT POST PRODUCTION	DESIGN CHANGES
Task 100: PROGRAM PLANNING AND CONTROL						
Early LSA Strategy (101)	X	X	X			
LSA Plan (102)		X	X	X	X	X
Prog/DSN Reviews (103)		X	X	X	X	X
Task 200: MISSION AND SUPPORT SYSTEM DEFINITION						
Use Study (201)	X	X	X	X		
System Standardization (202)		X	X	X		X
Comparative Analysis (203)	X	X	X	X		X
Technological Opportunities (204)		X	X			
Supportability Factors (205)		X	X	X		X
Task 300: PREPARATION AND EVALUATION OF ALTERNATIVES						
Func. Requir. Ident. (301)		X	X	X		X
Support System Alternatives (302)		X	X	X		
Evaluation of Alternatives & Trade-offs (303)		X	X	X		X
Task 400: DETERMINIATION OF LOGISTIC SUPPORT RESOURCE REQUIREMENTS						
Task Analysis (401)			X	X		X
Early Fielding (402)				X		X
Post Production Support (403)					X	X
Task 500: SUPPORTABILITY ASSESSMENT						
Supportability Assessment (Test, Evaluation and Verification)(501)		X	X	X	X	X

Task Section 100—Program Planning and Control

Management of the LSA effort requires the development of a proposed LSA strategy, tailoring decisions, requirements for the OSA plan, and design reviews, procedures and schedules. The LSA planning and management is the responsibility of the requiring authority program and ILS managers. If available, the ILSP provides guidance to the contractor.

Task Section 200—Mission and Support System Definition

The LSA effort is used to establish supportability objectives and supportability related design goals, thresholds, and constraints through comparison with existing systems and analyses of supportability, cost, and readiness drivers.

Task Section 300—Preparation and Evaluation Alternatives

The tasks contained in this section are highly iterative in nature and are applicable to successive phases of the preproduction part of the life cycle and to production design changes. The tasks are generally performed in sequence and the process is then iterated to increasingly lower levels of detail

Figure 2. LSAR DATA RECORDS/RELATIONSHIPS

DATA SHEET	RECORD TITLE	RELATED LSA TASK NO.
A	Operation and Maintenance Requirements	205
B	Item Reliability and Maintainability Characteristics	205, 301 401, 501
B1	FMEA	301
B2	Criticality and Maintainability Analysis	301
C	Operation and Maintenance Task Summary	301, 401, 501
D	Operation and Maintenance Task Analysis	301, 401, 501
D1	Personnel and Support Requirements	301, 401, 501
E	Support Equipment or Training Material Description and Justification	401, 501
E1	Unit Under Test (UUT) and Automatic Program(s)	401, 501
F	Facility Description and Justification	401, 501
G	Skill Evaluation and Justification	401, 501
H	Support Items Identification	401, 501
H1	Support Items Identification (Application Related)	401, 501
J	Transportability Engineering Characteristics	401, 501

in conjunction with the system engineering process.

Task Section 400—Determination of Logistics Support Resource Requirements

This portion of the LSA defines the requirements of the ILS elements. The tasks can be very costly and produce a considerable amount of documentation.

Task Section 500—Supportability Assessment

The supportability test and evaluation program is a vital part of the LSA process throughout a program life cycle. It must serve three objectives: (a) provide measured data for supportability design parameters as inputs to the system engineering, LCC, and support system design activities, (b) expose supportability problems for corrective action, and (c) demonstrate contractual compliance with design requirements.

VIII. LSA DOCUMENTATION

The LSAR data requirements are detailed in MIL-STD-1388-2A. The LSAR data are a subset of the LSA documentation and are generated as a result of performing the logistic support analysis tasks specified in MIL-STD-1388-1A. The MIL-STD-1388-2A is structured to accommodate the maximum range of data potentially required by all DOD services in all ILS element functional areas for all types of materiel systems, and through the entire acquisition life cycle. This approach permits standardization of formats and data definitions for government-required LSA data. Tailoring of these data requirements is a vital part of the ILS manager's role and will be discussed in a later paragraph. There are 14 LSAR standard data records. Figure 2 identifies these 14 data records and relates them to the applicable LSA tasks. There are many LSA tasks that are not documented by the LSAR. The output of these tasks may be documents such as the contractor's LSA Plan (Task 102), alternative support systems (Task 302), and fielding analysis (Task 402). If task results are to be delivered to the government, the LSA program statement of work must establish that requirement. The applicable DIDs must be specified and delivery

instruction cited on the CDRL, DD Form 1423. The ILS managers should be aware of the amount of documentation that is available. Only the LSAR data that are required should be ordered by the government. In other words, the ILS manager needs to determine what data are needed, and when. From this determination, he/she can identify output reports, LSAR data records, and tasks required to meet the needs.

IX. TAILORING THE LSA EFFORT

Tailoring LSA. The key to a productive and cost-effective LSA program is proper tailoring of the LSA subtasks so that the available resources are concentrated on the tasks which will most benefit the program. Limitations on acquisition funding require that the LSA effort be applied selectively in order to improve hardware design and support concepts, not merely to collect data. The government ILS manager plays a significant role in the tailoring process. Appendix A to MIL-STD-1388-1A provides excellent guidance in tailoring LSA requirements to fit the needs of a specific program.

Tailoring LSAR. Tailoring LSAR data is a mandatory requirement for government program and ILS managers. The tailoring decisions should be based on (a) the LSA tailoring process described in the preceding paragraph, (b) related engineering and ILS element analysis efforts that result in LSAR data, and (c) deliverable logistic products specified by DIDs to be included in the performing activity contract(s). In addition, LSAR data records utilization may be broken down by hardware level (system, subsystem, lowest repairable assembly, part, tools/TMDE/support equipment). Some data records are applicable to all hardware levels, and some are not applicable to any depending upon program requirements. Appendix E to MIL-STD-1388-2A provides detailed guidance for tailoring the LSAR.

X. SUMMARY

—The LSA process is mandatory for all materiel systems.

—Their applications must be tailored to the requirements of each acquisition to ensure cost-effective implementation.

—The program that provides front-end funding for LSA and other ILS activities is more likely to be successful.

FACT SHEET PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 4.5
Version: Update
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I. TITLE

Risk Management as a Means of Direction and Control

II. REFERENCES

—OMB Cir A109, "Major System Acquisition," Para 7, April 1976

—DODI 7041.3, "Economic Analysis and Program Evaluation for Resource Management, Para B, 7 October 1985

—*Risk Management Guide*, Defense Systems Management College, (TBP, January 1989)

—*Risk Management, Text and Cases*, Green & Serbein, 1978

—Data Item Descriptions (for inclusion in request for proposal):
UDI-A-23862A, "Risk Management Plan"
UDI-A-23865A, "Risk Assessment Report"
DI-S 3585, "High Risk and Long Lead Time Item List"

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IV. PURPOSE AND SCOPE

This fact sheet is designed to:

—Provide information on using risk management as a method of identifying program potential problems and controlling program objectives.
—Describe the components of the risk management process with information on the use of each component.
—Be general in scope and provide a structure applicable to all users.

V. DOD POLICY

—Each acquisition strategy is to be tailored with consideration of contractor and government risks (OMB CIR A109).

—A formal program of risk evaluation and reduction shall be established in each acquisition program. Elements of program risk are to be identified and assessed throughout the acquisition cycle. The programs acquisition strategy shall feature provisions for eliminating or reducing these risks to acceptable levels (DOD 4245.7).

—Each program manager is to assess the risk to the program of program objectives being realized

and present the risk of proposed management actions at each Defense Acquisition Board (DAB) meeting. When budget actions are suggested, the PM must be able to state not only the immediate impact to the program but must spell out the risk of other impacts downstream which are likely to result from the suggested action (DODI 7041.3).

—The decisions proposed on program actions are to be based on a reasonable amount of risk reduced before committment to a major increase in the application of resources toward full-scale development (DODD 5000.1).

—Technological risks of selected alternatives must be reduced by research and development and validated by test and evaluation before Milestone II (DODD 5000.2).

VI. BACKGROUND

In 1969, Deputy Secretary of Defense David Packard, wrote a memorandum to the military services in which he listed "inadequate risk assessment" as one of five major problem areas in system acquisition. Since that time, slow but steady progress has been made in surfacing program risk. The DOD Directive 5000.1 and DOD Instruction 5000.2, top acquisition policy documents, have become more specific in their requirement that risk analysis must be included as an integral part of the acquisition process. More recently, the DOD Acquisition Improvement Program that evolved from the 1981 Carlucci initiatives directed the military services to estimate most likely costs and to budget for risk. A result of this high-level recognition has been the development and implementation of such concepts as decision risk analysis, and network risk evaluations. In 1984, the Defense Science Board published its product on the risk in transitioning from development to production. This document became DOD Manual 4245.7M and is the primary guide for risk reduction for DOD Programs with risk templates to be used in the engineering process. A basic legitimacy has been established and a framework is in place to permit development and application of new methodologies.

VII. DEFINITIONS

—**Risk** is defined as the probability of an undesirable event occurring *and* the significance of the consequence of the occurrence.

—**Risk Management** is a method of managing that concentrates on identifying and controlling the areas or events that have a potential of causing unwanted change. The major areas of concern are usually cost, schedule, performance (technical), and supportability. Components of risk management include:

—**Risk Planning.** Sets the requirements for risk management.

—**Risk Assessment.** The process of examining a situation and identifying areas of potential risk.

—**Risk Analysis.** Examining the change of consequences with the modification of the risk input variables. This is more involved than risk assessment and should result in identification of the most critical variables with insights about desired options for risk handling.

—**Risk Handling Techniques.** The identification of options available to reduce or control selected areas of risk

—**Risk Control.** The process of achieving the plan by methods of continual application of management techniques to the risk items or areas.

VIII. RISK MANAGEMENT PROCESS

The risk management process is a discipline. It requires that a manager establish objectives and regularly assess his program for impediments to achieving these objectives. Usually, the process is iterative by first identifying the cost and risk drivers and then using management action to get the most critical drivers under control. While this subject has been called risk management, it is no more and no less than informed management. It can be used in any venture by placing in perspective the magnitude of the cause-and-effects of change and then developing options and making decisions to control the outcome.

Assessment of Risk. Any source of understanding may be considered a source of assessing or examining risk. Typical sources include:

—Lessons learned on similiar program
—Studies (expert interviews)
—Baseline cost estimate (review assumptions)
—Requirements document
—Risk modeling
—Program plans vs. actuals.

The task of risk assessment can be done best by a manager with a broad, high-level understanding of the business management perspectives of strategy and overall executability. Assessment in each discipline area, such as design engineering or logistics, can and should be performed by the discipline experts assigned to the PM office or in matrix support. The acquisition strategy should be selected based on assessed risk in each alternative; i.e., threat risk, schedule risk, technical risk, cost risk, and supportability risk.

Program actuals compared to program plans, with an understanding of economic and political trends, provide a beginning for assessing the overall program risk.

—Update Analysis of Risk. Analysis is conducted to determine where and when the consequence of risk is likely to occur, magnitude of exposure, the risk drivers, and the areas of greatest concern. The number of variables in a program make the use of models desirable. Recommended models include:

1. *Network Model.* Shows impact on the program when interdependent activities are modified. This should be a model that calculates both schedule and cost interdependent impacts.

2. *Life-Cycle Cost Model* with input data tailored to the phase of development and type of system being examined. This type of model should be used to determine the impact of changing performance parameters to the total system cost over system life. Additionally a life-cyle cost model should measure the affordability impact of the program by breaking out procurement cost and operations and support costs for each year.

3. *A Quick Reaction Model.* Can show the impact of changing production rates, quantities, and inflation. This model is required to answer the perennial "what-if" question that is always passed to the program manager as the service is going through the budget scrub. The answer to these questions is extremely important because the funding level is often decided as a result of the answer, and the program lives with the result.

Some products of risk analysis include the following:

—*Watch list.* This is a product of assessment and analysis and is necessary for risk control. Included should be the areas of risk along with the expected impact and ways of detecting and handling each risk identified. This is the most important of all the documents because it serves as the worksheet the managers continue to work from and record their progress. The items on the watch list are to provide insight about areas of highest risk and, therefore, those requiring attention. These items should have a criteria or standard developed against each to determine the acceptable performance projected over time. A control process should then be developed to assure adequate visibility to each risk area and to determine its progress against the standard as the program progresses.

—*Risk Presentations.* The references provided in paragraph II require that program risks be presented to decision-makers at each program review and decision point. Risk can be presented in several ways, the following are examples:

—Designators of risk should be shown for each major component considered. A common designation of "high, medium, low" may be against schedule, cost, supportability or technical, or it may be against components required performance parameters; i.e., percentage of capacity used, error rate in test, cost, integration of hardware, software design, or supportability.

—Use of a matrix to show actual values or relative values of cost, schedule or performance against each major task for each alternative considered.

—Risk Handling Techniques. This general term means "What do I do about it once risk has been identified and evaluated?" There are solutions or innovative ideas for handling risks but they all fall into one of the following categories: Avoidance, control (prevention), assumption, and transfer.

The technique selected will depend on where the program is in the acquisition process and the options available. The following explanations apply:

—Avoiding the risk is not to accept the option that has the potential consequence and its possible outcome. This is usually done by screening decisions. Source-selection evaluation is conducted to select the least risk contractor where the risk to be selected is a balance of all risks.

—Controlling risk is the process of continually sensing the condition of the program and developing options and fall-back positions to permit alternative

lower-risk solutions. This is the most involved of the processes and requires identifying risk areas with acceptance criteria and measurable thresholds.

—Assumption of the risk is an acknowledgement of the existence of the risk and a decision to accept the consequence if it occurs. This is like self insurance.

—Transfer of risk is a process of identifying areas of concern and potential risk, which others, in a position to share the risk, feel are of lesser concern. The result is an agreement, with the parties agreeing to share the risk, frequently with a premium paid by the party with the greatest risk. Included are warranties, incentive contracts, fixed-price contracts, insurance policies, etc.

IX. REQUIREMENTS IN THE CONTRACT FOR RISK INFORMATION

The contractor is the primary source of risk information. The proposal for future contracts is likely to require that risk assessments be done in response to one of the data item descriptors referenced, or from a unique data item descriptor. *Evaluation criteria can be expected to include* questions on handling risk. Military project managers do not expect contractors to reveal areas of risk in their proposals. These are areas of vulnerability in a competitive evaluation. Government project managers do, however, expect contractors to know their requirements to understand the risk and that managing it accordingly be shared by industry program managers.

X. RISK CONTROL PROCESSES

Controlling risk is a continuous task throughout the management of a program involving every manager. For the program manager to get full control, he/she needs to have the information on risk of subordinate functions consolidated in a single document, or "war room," for review.

There are an infinite number of methods you may use to control risk. There are a few, however, that recently have been used and found to be worthy of mention. The MK50 Torpedo has used a formal risk control process, with Honeywell as the prime contractor. This technique includes the identification of the highest risk items in the program and developing a criteria and visual plot for each item. The information for each item is then included in a WBS breakdown fashion in a booklet that permits the assessment of the risk at any level, and an identification of the times or components of risk for each area. The book is put together so that risk components can be quickly referenced by page reference from the higher WBS level.

A second method used frequently by program managers of ship overhaul functions includes the identification of wear-out factors of components and plumbing on board ship. As the ship goes through exercises at sea, faulty or suspect items are identified and placed in the risk watch list. As the components and risk area are assessed by the risk manager, materials and schedule requirements and their probabilities are run through a risk network model for better estimation. This permits the ordering of parts and scheduling of repairs while the ship is still at sea, with faster turnaround and considerable savings in dollars.

A different method used by some in space activities involves examining plans and applying standard deviation distributions against reasonableness. Each item or area of high consequence is evaluated for reasonableness with that distribution. The result of this approach is a sequential listing of the critical or high-risk contributors ordered as to the degree of risk contributions.

XI. SUMMARY

Risk management is a management and control process. It is the means by which program areas of vulnerability and concern are identified and managed. Once a criterion or standard is developed for each item or function and plotted over time, the plotting of actuals against that planned standard provides sufficient information to alert the manager to required action. The continuous use of risk identification and management provides the needed information for decisions and decision reviews at higher levels.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 4.6
Version: Update
Date: December 1988

I. TITLE

Design to Cost Management

II. REFERENCES

—DOD Directive 4245.3, "Design To Cost," 6 April 1983

—DARCOM P700-6, NAVMAT P5242, AFLCP/AFSCP 800-19, "Joint Design-To-Cost Guide," 15 October 1977

—AR 70-64, "Design to Cost," 1 January 1983, with Change 1 dated 15 July 1985

SECNAVINST 4200.32, "Design to Cost," 12 July 1984

—MIL-HDBK-259 (Navy), Life-Cycle Cost in Navy Acquisition," 1 April 1983

—AF Regulation 800-11, "Life-Cycle Cost Management Program," 27 October 1983

III. POINTS OF CONTACT

—Defense Product Engineering Services Office
Resource Management and Analysis Division (PESO-XC)
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Cameron Station
Alexandria, VA 22304-6183
(703) 756-2320; AV 284-2320

—Headquarters, US Army Material Command
ATTN: AMCDE-A
5001 Eisenhower Ave.
Alexandria, VA 22333-01
(202) 284-9320

—Office of the Assistant Secretary of the Navy, Shipbuilding and Logistics/Contracts and Business Management Directorate (0232)
Department of the Navy
Washington, D.C. 20360
(202) 692-7521; AV 222-7521

—Headquarters, Air Force Systems Command (AFSC/PLE)
Andrews AFB, MD 20334-5001
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IV. PURPOSE AND SCOPE

This fact sheet is designed to:

—Summarize the design to cost (DTC) concept.
—Describe the DOD policy
—Outline the DOD procedural requirements
—Describe implementation considerations

V. DTC CONCEPT

Design to cost is an acquisition management technique used to control program costs, specifically production and ownership (operations & support) costs. The intent is to influence production and ownership costs during the design/development phases (concept exploration definition through full-scale development) by focusing on the cost and performance trade-offs needed to define an affordable system that meets or exceeds required performance levels. The DTC objective is to achieve a proper balance among production and operation and suppport (O&S) costs; that balance will vary from program to program depending on the particular requirements a program manager is attempting to satisfy.

A DTC program is one of several management tools used to control program life-cycle costs. Development cost management is addressed, for example, by implementing "Cost/Schedule Control Systems Criteria" (DODI 7000.2) and "Cost Performance Reporting" (DODI 7000.10) requirements in development contracts. To be effective, control of production and O&S costs must also be addressed in development contracts. Cost must be made an active design parameter for engineers. A specific unit production cost goal and threshold must be established, tracked, and compared to negotiated production costs. Similarly, specific O&S parameters must be selected and tracked until the level of achievement can be determined in circumstances that approximate a mature operating environment.

VI. DOD POLICY

It is the policy of the DOD to:

—Establish cost as a parameter equal in importance to technical and supportability requirement and schedules.

—Establish credible acquisition (that is, average unit flyaway cost) and O&S DTC parameters that are consistent with program plans and budgets and that achieve the best balance among cost, schedule, performance, reliability, and supportability characteristics.

—Require that cost considerations be addressed throughout the design, development, production, and deployment of defense systems, subsystems, and equipment.

—Ensure prompt cost feedback to engineers and managers to enable effective and timely cost reduction actions.

The provisions of DOD 4245.3, "Design to Cost," apply to major systems as defined by DOD 5000.1, "Major System Acquisition." The DOD components must determine the criteria for applying DTC requirements to systems and equipment that are not major system acquisitions. When implemented on non-major systems, DTC principles must be applied in a manner similar to major systems. (NOTE: Army programs with forecasted production costs of $40 million or more must establish a DTC program).

VII. DOD PRECEDURAL REQUIREMENTS

For production, a DTC goal and threshold will be established in the form of average unit flyaway (rollaway or sailaway) cost as defined in DODI 5000.33, "Uniform Budget/Cost Terms and Definitions." Flyaway cost goals must be established based on the total planned quantity at defined production rates. Cost goals and thresholds must be expressed in constant year dollars.

The DTC parameters for O&S may be expressed in dollars or by other measurable factors such as unit operating crew and maintenance manpower requirements, or operational and logistics reliability and maintainability requirements. Design controllable factors should be selected in accordance with DODD 5000.40, "Reliability and Maintainability," and should be those that:

—Significantly affect the O&S costs (cost drivers must be linked to the design process);

—Can be measured during test and evaluation and in the operational environment.

During concept exploration definition, a program manager must establish DTC objectives for his system. Objectives are tentative values subject to revision and trade-off until firm goals and thresholds are established. A program manager's ability to establish a DTC objective, for instance an average unit flyaway cost objective, at the outset of concept exploration may be constrained by the type of system and overall knowledge of possible production costs. Conversely, a program manager may establish, or may have imposed, a definitive flyaway cost goal at the outset of the program. In either situation, DTC objectives must be provided in the system concept paper prepared for the Milestone I review. These objectives may be derived from contractor proposals as well as the program office's independent cost estimates.

Not later than final commitment to the full-scale development contract (or Milestone II review, whichever is earlier), the program manager must establish:

—DTC goals—firm costs or values that should be attained.

—DTC thresholds—costs or values that, if exceeded, will cause a program review.

Approved goals and thresholds will be included in the secretary of Acquisition Decision Memorandum (ADM) and can only be changed by the Secretary of Defense or designee. Approved changes will be incorporated in the next version of the ADM. If the program manager determines that DTC thresholds will be breached, line officials and the defense acquisition executive (DAE) must be notified. The program manager's recommended alternative courses of action must include a "zero cost growth alternative"; i.e., a plan of action identifying specific changes necessary to reduce forecasted costs of the required inventory to approved DTC goals and thresholds.

The DTC parameters will include costs necessary to accommodate preplanned product improvements unless it is impractical to do so. In that case, separate DTC goals and thresholds must be developed for the preplanned product improvement and managed in a manner similar to the original acquisition effort.

Exemptions to the requirements of DOD 4245.3 may be approved only by the secretary of defense or designee. Two general program categories are recognized as possible candidates for exemption:

—Those few programs that, for national security reasons, have performance or schedule requirements that must take precedence over cost considerations.

—Those programs where it may be appropriate to propose DTC parameters based on other than flyaway and O&S cost; e.g., in programs where hardware or software development is a predominant fraction of the acquisition cost and production volume is extremely low or where variable subsystems make up a system.

VIII. IMPLEMENTATION CONSIDERATIONS

—General

—Implementing a DTC program is a multidisciplined task that draws upon a variety of functional areas. It should be implemented as part of the systems engineering process where cost and O&S parameter (i.e., reliability and maintainability targets) are allocated to design engineers just as performance parameters are allocated via the work breakdown structure (WBS). During the iterative design process, logistics, procurement, manufacturing, and business management input is used in trade-off analyses to strike the balance between production and O&S costs.

—Flyaway Costs

The flyaway cost category, by definition, includes costs that are a government responsibility. Examples include government furnished equipment and government recurring and non-recurring costs. Contractually established cost goals and thresholds will, therefore, most likely be different than the flyaway cost established in the ADM. The use of a "Design to Unit Production Cost" goal, which normally only includes recurring production costs, is one example of a cost category that is a subset of flyaway costs. It may be appropriate to subdivide the total goal and allocate specific cost targets to major subsystems; e.g., airframe, engine, avionics, using the WBS. These allocations should be included in the prime contract and, if appropriate, principal subcontracts. These allocations help program personnel to focus on high-risk or high-cost subsystem/components that are life-cycle cost drivers.

The initial flyaway cost objective is based on several assumptions: total production quantity, production rate, schedule, and learning curve. If these assumptions change (i.e., total quantity or rate), then the average unit flyaway cost will change. It is, therefore, appropriate to contractually establish a procedure to accommodate change. This is particularly important if incentives are linked to achieving DTC goals. Other factors used to establish the initial flyaway cost goal may include, for example, specific WBS elements included within the cost goal, specific direct and indirect costs, cost and inflation indices, and cost of initial production facilities, if appropriate.

Materials and subcontracts normally account for a substantial part of the weapon system cost. The program manager must determine if it is appropriate to "flow down" DTC requirements to subcontractors and then establish requirements for the prime contractor accordingly. If subcontractors are included and the program includes incentives, it may be appropriate to establish a certain portion of the incentives for subcontractors.

—Incentives

Contracting procedures should include DTC incentives to provide a financial reward to contractors after a demonstration that actual costs or other measureable factors are at, or below, stated DTC goals. The DODD 4245.3 specifically excludes the payment of incentives for activities with unsubstantiated cost benefits to the government. For example, a contractor may be required to conduct trade studies for which he is paid; however, no incentives can be applied to this effort. Incentives must be tied to demonstrated performance: a negotiated production contract with costs at or below stated goals, or, on the O&S side, a demonstration that reliability and maintainability parameters have been met.

Competitive development contracts require different incentive considerations than do sole-source contracts. During competitive phases, competition is normally a sufficient motivator to achieve program objectives, since competitors focus on winning the follow-on contracts. Therefore, future production and O&S costs should be important criteria during source selection for follow-on contracts. Sole-source development contracts should include DTC incentives large enough to ensure the contractor will try to attain the DTC parameters. As previously mentioned, consideration should be given to making incentives available to subcontractors. (NOTE: Program managers must recognize that, while sole-source situations may occur during development, the emphasis is on maintaining a competitive environment, to include dual-sourcing in production).

Incentives must be structured in light of overall acquisition strategy and program objectives. Considerations include the type of warranty to be used, or when value engineering will be applied. Incentives, warranties, value engineering techniques, and other types of product performance requirements must be mutually supporting.

—DTC Reporting and Tracking.

Reporting varies by service and by program. A selected acquisition report (SAR) program should consider, as a minimum, a quarterly report to provide the latest contractor input for the quarterly SAR. Standard data item descriptions (DID) are available. Many development commands within each service have established DIDs to support their particular type of system. The key, however, is to structure a reporting and tracking system that serves the needs of your program, while always keeping in mind the cost to administer a DTC program.

—Management

Studies by the Army and Navy indicates varying degrees of success with DTC programs. While problems continue to exist (e.g., contractually accommodating quantity or rate changes), both services studies concluded that active involvement by both the government and industry program managers is fundamental to success. To state it another way, industry will respond to what the government considers improtant and emphasized throughout the program life cycle.

IX. SUMMARY

The DTC is a management technique for controlling production and O&S costs. Goals and thresholds are established for both average unit flyaway cost and selected O&S parameters that represent significant life-cycle cost drivers. During development, cost and O&S parameters are active design parameters, similar to technical and performance requirements, which are applied during the systems engineering process. Incentives must be tied to actual, demonstrated performance that the established thresholds have been met or exceeded. Active involvement by the program manger is the key to success.

FACT SHEET PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 4.7
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I. TITLE

Mission Critical Computer Resource (MCCR) Policy

II. REFERENCES

—DOD Directive 5000.1, "Major and Non-Major Acquisition Programs," September 1, 1987

—DOD Instruction 5000.2, "Defense Acquisition Program Procedures," September 1, 1987

—DOD Directive 5000.3, "Test and Evaluation," December 26, 1976

—DOD Directive 5000.29, "Management of Computer Resources in Major Defense Systems," April 26, 1976

—DOD Directive 3405.1, "Computer Programming Language Policy," April 2, 1987

—DOD Directive 3405.2, "Use of Ada® in Weapon Systems," March 30, 1987

—DOD-STD-2167A, "Defense Systems Software Development," February 29, 1988

—DOD-STD-2168, "Defense System Software Quality Program," April 29, 1988

III. POINTS OF CONTACT

Office of the Under Secretary of Defense (Research and Advanced Technology) Computer Systems and Software, Pentagon, Washington, D.C. 20301.

IV. PURPOSE AND SCOPE

This fact sheet:

—Describes the historical background for Department of Defense (DOD) policy in MCCR.

—Identifies the top-level DOD policy guidance on MCCR.

—Examines current DOD initiatives in MCCR policy.

V. POLICY

Policy matters are covered in the remaining sections of this fact sheet.

VI. HISTORICAL BACKGROUND

The Department of Defense (DOD) acquisition policy pertaining to computer resources has been, and still is, based in part on public law. Since the enactment of the Brooks Bill (Public Law 89-306) in October 1965, the General Service Administration (GSA) has been responsible for the economic and efficient purchase, lease, maintenance, operation, and utilization of automated data processing equipment by federal departments and agencies. In the early days of computer hardware and software application, there was no initial distinction made between general-purpose business, financial-type applications, and the special purpose DOD weapon system applications of computers. However, the uniqueness of DOD weapon system computer applications was recognized by exempting that class of computers, called embedded computer resources (ECR), from the provisions of the Brooks Bill. The ECR elements have been managed under provisions of the DOD acquisition system, instead of management by GSA procedures. During the 1970s, and until 1982, the term ECR included a narrowly defined class of computer equipment, software, documentation, personnel, and facilities integral to a defense weapon system.

Section 908 of the FY 1982 Defense Authorization Bill (Warner-Nunn Amendment) broadened the class of computer resources exempted from the Brooks Bill, and was the genesis of the new term, *mission critical computer resources*. The Warner-Nunn Amendment included as mission critical computer resources those:

—Involving intelligence activities
—Involving cryptological activities
—Involving command and control
—Involving equipment that is an integral part of a weapon or weapon system
—Critical to direct fulfillment of military or intelligence missions.

The real significance of the extended definition is that many more computer systems can now be acquired using DOD acquisition procedures, giving the program manager more direct management control over a key element of the system.

The originally defined ECR and the currently defined MCCR have been, and are, managed under provisions of DODD 5000.29. Management implications of that directive are the main dicussion subject of this fact sheet.

VII. DOD POLICY

Mission critical computer resources are developed and acquired under policies and procedures directed in DOD Directives 5000.1, 5000.2, and 5000.3 as specifically promulgated in DODD 5000.29, "Management of Computer Resources in Major Defense System," April 26, 1976. The DODD 5000.29 was issued to place required emphasis on critical management aspects of MCCR. The central theme and key general direction given in DODD 5000.29 is stated as follows:

"Computer resources in Defense Systems must be managed as elements or subsystems of major importance during conceptual, validation, full-scale development, production, deployment, and support phases of the life cycle, with particular emphasis on computer software and its integration with the surrounding hardware."

The DODD 5000.29 contains specific policy direction requiring definitive program management action in the following areas:
—Requirements validation
—Risk analysis
—Configuration management
—Life-cycle planning
—Support software deliverables
—Milestone definition/criteria
—High order language standardization.

Requirements Validation. Validation of computer resource requirements must be conducted during concept exploration and demonstration/validation phases of the weapon system acquisition process. The requirements validation should involve formal government consideration of performance requirements, operation environments, user needs, and support requirements. The validation should assure planned computer resources will satisfy the system's operational requirements. The requirements validation process continues through the development cycle and is carried out through a series of formal reviews including the system requirements review, system design review, preliminary design review, and critical design review.

Risk Analysis. A risk analysis, including plans for risk resolution, is required in support of milestone decision points. The decision coordinating paper and integrated program summary for Milestone II should identify computer resource risk areas and propose strategies for risk resolution. Corrections of software reliability, integrity, maintainability, ease of modification, and transferability are to be considered in the risk analysis.

Configuration Management. Formal configuration management procedures are required for computer hardware and software. Computer hardware and software must be identified as configuration items and undergo the change control, status accounting, and configuration audits involved in the configuration management process. Configuration management procedures must be applied to provide for proper requirements allocation through dedicated computer hardware and software specifications. Formal government requirements validation can then occur through a series of reviews, and the resultant approval of functional, allocated, and product baselines.

Life-Cycle Planning. A Computer Resources Life-Cycle Management Plan (CRLCMP) covering development and support requirements must be prepared before Milestone II and be maintained throughout the life cycle. The CRLCMP must cover the complete spectrum of activities and resources needed to develop and then support computer resources. The Software Development Plan (SDP) is prepared typically by the contractor who will actually develop the computer resources. The CRLCMP should be prepared by the government, especially in cases where significant government organic support of computer resources is planned. Planning is required to ensure the timely availability

of hardware and software, facilities, and trained personnel to support the computer resources system throughout the life cycle. The plan must cover management procedures and organizational requirements such as configuration management organization relationships.

Support Software Deliverables. Certain items of software will be needed to develop and maintain the computer resources during the life cycle of the system. Those resources, such as compilers, assemblers, editors, simulators, debuggers, and all supporting documentation, must be specified as deliverables with appropriate rights granted to the DOD for their design and use. Consideration of support equipment needed, or already in place in government support facilities, must be made to assure a proper match between the availability of deliverable support software and the government support facility requirements.

Milestone Definition/Criteria. The directive calls for the establishment of specific milestones in the development cycle of computer resources. The milestones must involve properly sequenced events such as analysis, design, coding, test, operation, and maintenance. There must be a well-defined procedural path through the events ranging from requirements allocation through deployment. The milestone system is applied best when one milestone results in a definable product, such as a development specification. This leads to activities in a next phase, intended to culminate in the next milestone, at which another set of specific criteria are met to ensure adequate progress in the development process.

Higher-Order Language (HOL) Standardization. Since 1976, it has been required that DOD approved HOLs be used for weapon system applications. Approved HOLs were specified in the interim DOD Instruction 5000.31. The following languages were included as approved HOLs to be controlled by designated control agents to ensure language stability and configuration management:

—CMS-2 (USN)
—SPL-1 (USN)
—TACPOL (USA)
—JOVIAL (USAF)
—COBOL (OSD/C)
—FORTRAN (OSD/C)

The ATLAS programming language for Automatic Test Equipment (ATE) was added as an approved HOL in 1978.

VIII. POLICY INITIATIVES

There have been policy direction changes regarding HOLs and the procedures for developing software.

HOL POLICY (Ada). On June 10, 1983, Dr. Richard DeLauer (then USDRE) issued a directive memorandum titled, "Interim DOD Policy on Computer Programming Languages." The key policy change regarding use of the DOD new standard HOL, Ada, is expressed in the following quote from the memorandum:

"Ada* (ANSI/MIL-STD-1815A) is approved for use consistent with the introduction plans of the individual components and the validation requirements of the Ada Joint Program Office. The Ada programming language shall become the single, common computer programming language for DOD mission-critical applications. Effective 1 January 1984 for programs entering Full-Scale Engineering Development, Ada shall be the programming language. "Mission-critical" applications are those exempted from the Brooks Bill by 10 U.S.C. 2315, the Warner Amendment to the FY 1982 Defense Authorization Act."

Since then, two DOD directives were promulgated establishing DOD policy for computer programming languages used in development and support of all DOD Software and establishing Ada as the single, common computer programming language for MCCR. The DOD Directive 3405.1 provides a listing of the approved DOD HOLs and their designated control agencies:

—Ada	(Ada Joint Program Office)
—C/ATLAS	(USN)
—CMS-2M	(USN)
—CMS-2Y	(USN)
—FORTRAN	(USAF)
—JOVIAL	(USAF)
—Minimal BASIC	(USAF)
—PASCAL	(USAF)
—SPL/1	(USN)

The DOD Directive 3405.2 establishes policy on using Ada in computers integral to weapon

systems. The Ada language is controlled by the DOD to the extent that Ada compilers must be validated by the DOD before use on a DOD program. The DOD program manager must be aware of the validation status of the Ada compiler and of the host and target computer availability of such compilers. If there is not an Ada compiler hosted on a computer available to the PM or the development contractor, the PM will be forced to include development of an Ada compiler as part of the project. The same concerns apply to the availability of an Ada compiler targeted to the application computer.

SOFTWARE DEVELOPMENT STANDARD. The Joint Logistics Commanders Joint Policy Coordinating Group on Computer Resource Management conducted a software standardization program with the goal of developing a disciplined standard approach to DOD software development. That program initially resulted in the issue of DOD-STD 2167, "Defense System Software Development" in 1985 and was updated and published as DOD-STD-2167A in February 1988. The standard outlined the software development cycle (Figure 1) to be used in DOD software development. The application of DOD-STD-2167A provided more accurate visibility into software development status. The task of the program manager is to contract for the efforts required to accomplish the software development using those procedures.

The DOD-STD-2168, "Defense System Software Quality Program," was published April 29, 1988. It is to be used in conjunction with DOD-STD-2167A and contains requirements for the development, documentation, and implementation of a software quality program. Table 1 lists the revised data items description (DIDs) associated with these two standards.

Figure 1. LIFE CYCLE PHASE ACTIVITIES

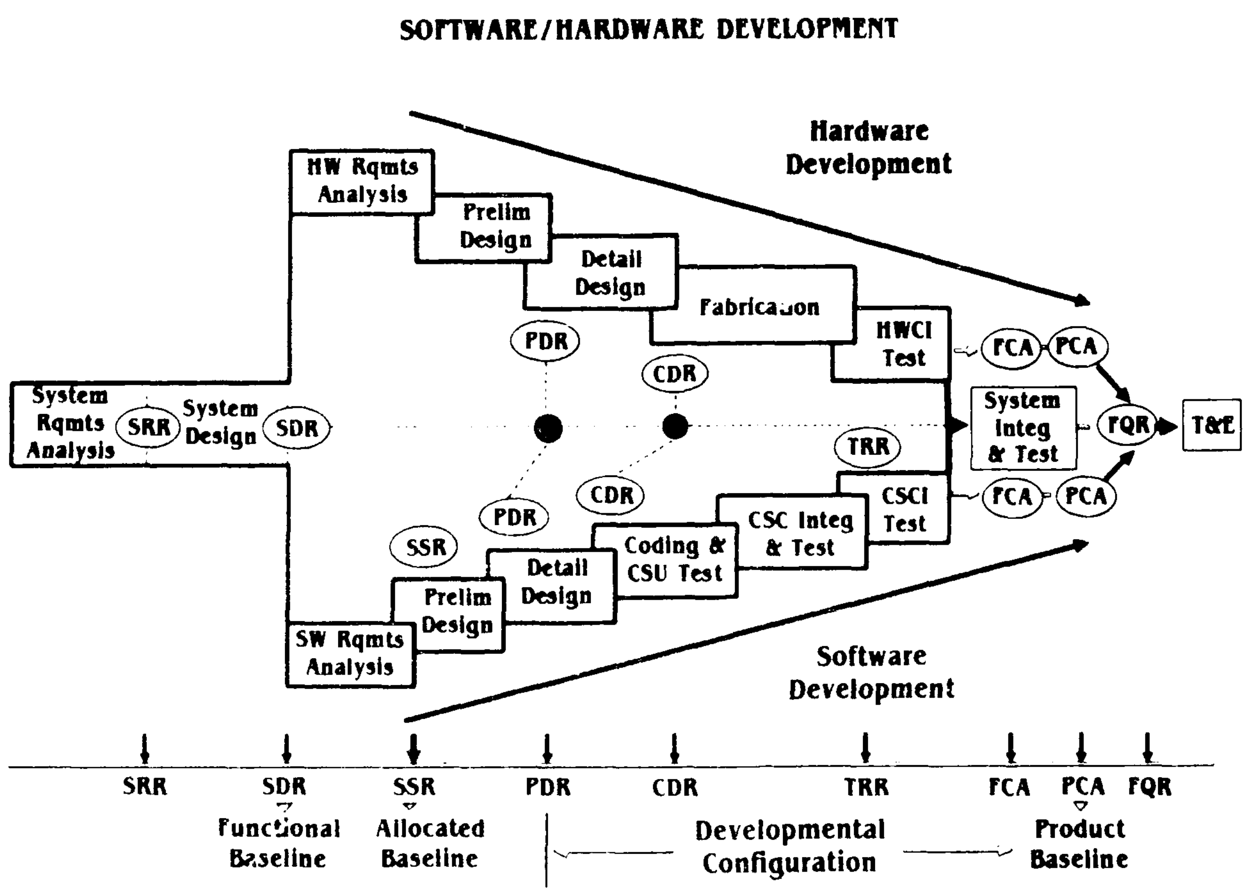

Table 1. DATA ITEM DESCRIPTIONS (DOD-STD-2167A and DOD-STD-2168)

TITLE	NUMBER
SYSTEM/SEGMENT SPECIFICATION (SSS)	DI-CMAN-80008A
SYSTEM/SEGMENT DESIGN DOCUMENT (SSDD)	DI-CMAN-80534A
SOFTWARE DESIGN DOCUMENT (SDD)	DI-MCCR-80012A
VERSION DESCRIPTION DOCUMENT (VDD)	DI-MCCR-80013A
SOFTWARE TEST PLAN (STP)	DI-MCCR-80014A
SOFTWARE TEST DESCRIPTION (STD)	DI-MCCR-80015A
SOFTWARE TEST REPORT (STR)	DI-MCCR-80017A
COMPUTER SYSTEM OPERATOR'S MANUAL (CSOM)	DI-MCCR-80018A
SOFTWARE USER'S MANUAL (SUM)	DI-MCCR-80019A
SOFTWARE PROGRAMMER'S MANUAL (SPM)	DI-MCCR-80021A
FIRMWARE SUPPORT MANUAL (FSM)	DI-MCCR-80022A
COMPUTER RESOURCES INTEGRATED SUPPORT (CRISD)	DI-MCCR-80024A
SOFTWARE REQUIREMENTS SPECIFICATION (SRS)	DI-MCCR-80025A
INTERFACE REQUIREMENTS SPECIFICATION (IRS)	DI-MCCR-80026A
INTERFACE DESIGN DOCUMENT (IDD)	DI-MCCR-80027A
SOFTWARE PRODUCT SPECIFICATION (SPS)	DI-MCCR-80029A
SOFTWARE DEVELOPMENT PLAN (SDP)	DI-MCCR-80030A
SOFTWARE QUALITY PROGRAM PLAN (SQPP)	DI-QCIC-80572

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

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I. TITLE

Specification Management

II. REFERENCES

—DODD 4120.3, "Defense Standardization and Specification Program"

—DODD 4120.21, "Specifications and Standards Application"

—MIL-S-83490, "Specification, Types and Forms"

—MIL-STD-490A, "Specification Practices"

— MIL-STD-499A, "Engineering Management"

—MIL-STD-1521B, "Technical Review and Audits for Systems, Equipments, and Computer Software"

—MIL-STD-483A, "Configuration Management Practices for Systems, Equipment, Munitions and Computer Programs"

—DODI 4120.20, "Development and Use of Non-Government Specifications and Standards," 18 December 1976

—SD-B, "An Overview of the Defense Standardization and Specification Program," 1 May 1983

III. POINTS OF CONTACT

Defense Material Specification and
Standardization Office
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Washington, D.C. 20301

Headquarters, U.S. Army Materiel Command
(AMCDE-PE)
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Alexandria, VA 22333
(202) 274-9203; AV 284-9203

Office of Naval Acquisition Support
(Code-05)
Washington, D.C. 20360-5000
(202) 692-0815; AV 222-0815

Air Force Systems Command
(AFSC/SDM)
Andrews AFB, MD 20331
(301) 981-3316; AV 858-3316

IV. POLICY

Specifications, standards, and other engineering documentation should be written to state only the actual needs of the government in a manner to foster maximum competition. To ensure competitive concept development, DOD policy states that maximum use should be made of process standards and functional specifications which include only minimum requirements. Specifications stated in detailed and "how to" language should be avoided. In solicitations, the number of specified government specifications and standards shall be minimized.

Tailoring shall be utilized to ensure that only sections of the selected specification, standards and documents related to the program will be incorporated.

Competing contractors in each acquisition phase are required to identify, rationalize, and propose for government approval, contractually applicable specifications and other requirements for each succeeding phase in the acquisition cycle from mission identification through full-scale development, production and support.

V. PURPOSE

This fact sheet is intended to give a general overview of the specification generation and management process. In particular it will:

—Define the term specification and terms related to specification development

—Define the basic forms and types of specifications

—Define documents that govern specification preparation

—Summarize the content of a system specification

—Discuss considerations in the preparation of a specification.

VI. DEFINITIONS

—**Specifications** are documents prepared to support acquisition. They establish requirements in terms of complete design details and performance levels in order to permit solicitations of competitive bids. They include procedures necessary to determine compliance with proposed requirements.

—**Federal specifications** are developed for materials, products or services used by federal agencies other than DOD.

—**Military specifications** are developed for materials products or services developed for the military.

—**Standards, handbooks and drawings** are documents used in conjunction with the specification. A brief definition of each of these documents follows:

—*Standards* establish engineering and technical requirements for processes, procedures, practices, and methods that have been adopted as standard. They control variety and include materials, items, definitions, nomenclature, test methods and inspection, packaging and preservation methods and materials engineering practices and processes, codes, symbols, type designations, etc.

—*Handbooks* bring together procedural and technical/design information related to commodites processes, practices and services. They may serve as a supplement to a specification to provide general design and agency data.

—*Drawings* are references in many standardization documents. Also, specification and standards are referenced in drawings to identify materials, processes and standard items incorporated in assemblies and equipment.

There are two categories of specifications. The first category is general specifications, which: 1) are called military specifications/standards; 2) apply to all acquisition programs; 3) are controlled by the Defense Standardization and Specification Program (DSSP); 4) include specification for materials, parts, processes, test criteria documentation, management and the "ilities"; and 5) total more than 44,000. The second category is program unique specifications, which are developed: 1) from narrow user requirements and 2) for specific products to be acquired to meet program unique requirements.

This fact sheet deals primarily with the program unique specifications which are the products of the systems engineering process. Specifications play an integral role in the design review process. *Part I (design to)* specifications state functional *performance* requirements and serve as the basis for test plan development. *Part II (build to) specifications state design* requirements. The relationship of the specifications to the acquisition cycle is shown in Figure 1.

Types and forms of program specifications are as follows:

Type	**Definition**
A	System Functional Specification
B	Development Specification (Part I)
C	Product Specification (Part II)
D	Process Specification
E	Material Specification

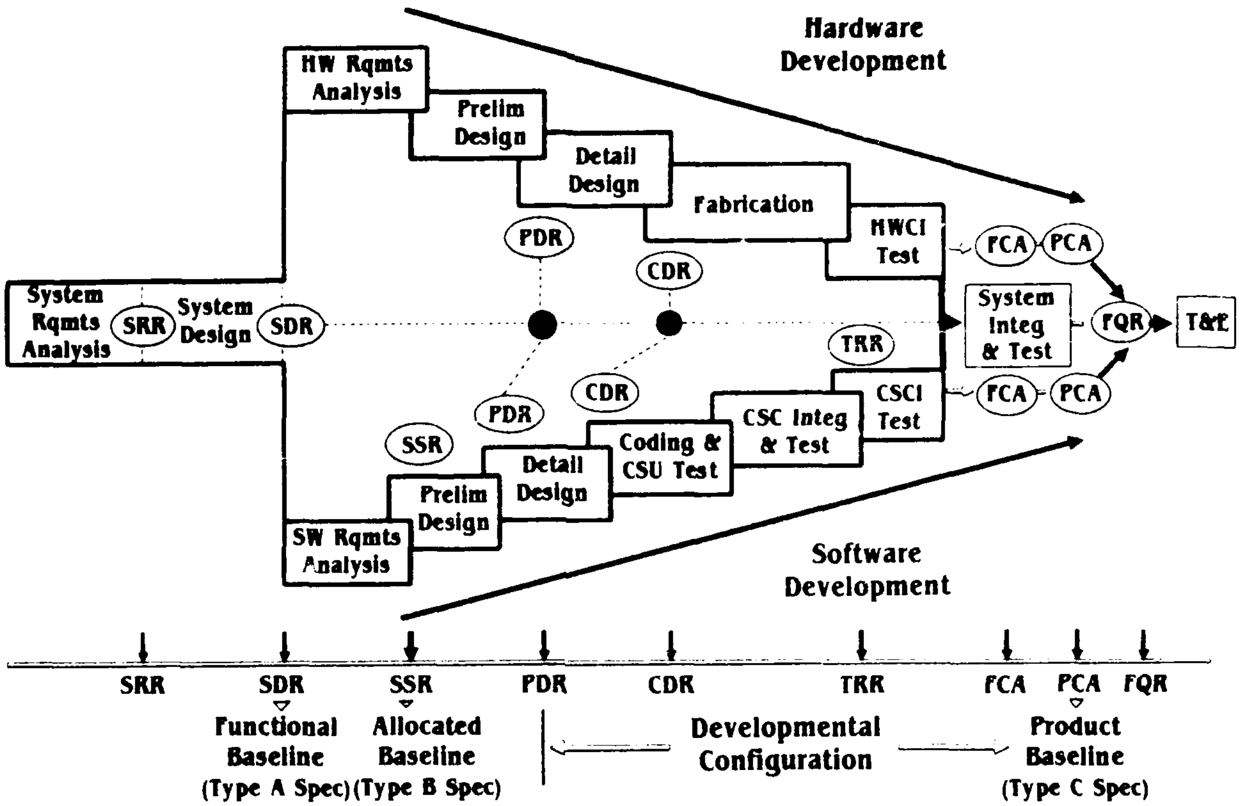
Standard specifications contain sections on: 1) scope, 2) applicable documents, 3) requirements, 4) quality assurance, 5) preparation for delivery, 6) notes, and 7) appendices. A definition of the generally accepted/required contents of each section of the *system specification* is shown in Attachment 1. A detailed account of the required contents of all types of specifications is given in the appendices to MIL-STD-490A.

VII. IMPLEMENTATION

The system, development, and product specifications are among the most important documents produced during the acquisition process. A specification, intended primarily for use in procurement, should accurately describe the essential

Figure 1. LIFE CYCLE PHASE ACTIVITIES

SOFTWARE/HARDWARE DEVELOPMENT



technical requirements for items, materials, or services, including the procedures for determining that the requirements have been met.

System and equipment specifications, when invoked by a contract, are part of that contract and are legally enforceable. *The preparation, review, and maintenance of the program's specifications are activities worthy of the most competent members of the PMO and need the undivided attention of one or more people who are skilled in specification matters.*

Specifications are living documents that must be reviewed, maintained, changed, and updated to eliminate ambiguities, errors, and unnecessary requirements, and to reflect the current realities of total program requirements.

As system complexity grows and the number of recognizable subsystems increases, it will be helpful to have a specification tree prepared. The tree should contain a rank-and-order listing of all system, subsystem, equipment assembly, and component specifications that will be required to support the acquisition process and the spare-parts procurement program. The tree should show, for each specification, the program office team member responsible for specifications, review and approval; the date when approval is required; and current status. Status reviews of the specification tree should be scheduled, as necessary, by the program office.

Specifications established during the system acquisition process differ for each phase. They should state only the actual minimum needs of the government, and describe supplies and services to encourage competition among qualified suppliers. They should avoid restrictive requirements that might inhibit submission of acceptable proposals.

As the program progresses, specifications will become more detailed. Figure 2 shows the progressive development of the program specifications.

Some specification activity that takes place in the program management office (PMO) during each phase of system acquisition follows.

Concept Exploration/Definition Phase (CE/D)

Material provided in the solicitation for system design concepts should avoid specification in terms of equipment; rather, it should explain the need in mission or capability terms, schedule objectives and constraints, project cost objectives, and operational constraints.

Concept Demonstration/Validation Phase (CD/V)

After the concept exploration/definition phase, each contractor, (in collaboration with the PMO), selected to participate in the CD/V phase should have prepared and submitted a system (Type A) specification. The system specification, as defined in MIL-STD 490A, is "a document which states the technical and mission requirements for a system as an entity, allocates requirements to functional area (or configuration items) and defines the interfaces among the functional areas." The system specification should be devoid of all details that could inhibit the construction of critical subsystems equipment, and components, or the demonstration of the concept's technological feasibility. The system specification establishes the functional baseline configuration for a proposed system.

Full-Scale Development Phase (FSD)

After the M/S I, the system specification will have been refined. The refined specifications will update system performance and compatibility requirements and reflect the current definition of the system and the allocation of requirements to the several functional areas or configuration items. In addition, each competing contractor should have submitted a series of proposed development (Type B) specifications. The development specification, as defined in MIL-STD 490A, is "a document applicable to an item below the system level which states performance, interface, and other technical requirements in sufficient detail to permit its design, engineering for service use, and evaluation." The updated system specification and the series of approved development specifications constitute the allocated baseline configuration. The specifications should not contain a degree of detail that would inhibit the important trade-off studies and design evolution process vital to this phase.

Production and Deployment Phase

After the FSD phase, the contractor(s) (in close collaboration with the PMO) should have provided a final update of the development specification and a series of production specifications. A product (Type C) specification, as defined in MIL-STD 490A, is "a document applicable to a production item below the system level which states item characteristics in a manner suitable for procurement, production, and acceptance." The production specifications (Types C, D and E) should provide all the detail necessary to permit economical procurement of functional elements that, when assembled into a system, will perform as a system in accordance with the current system specification.

VIII. AREAS OF CONCERN

Excess application of general military specifications/standards. This practice leads to incompatible and excessive requirements.

Specifications applied in "blanket" manner. Results in tiering of military specifications and excessive requirements.

Overstatement of requirements. Results in dictating a solution to the design problem and statement of unnecessary functions.

Overdesign. Can lead to costly manufacture, exhaustive quality tests, complex design and excessive performance requirements.

Under-application. Relates to the imprudent omission of essential specifications. May result in 1) reduced operational capability, 2) reduced performance, 3) increased life-cycle cost, and/or 4) early obsolescence.

IX. THE SYSTEMS ENGINEERING MANAGEMENT PLAN (SEMP)

The following topics concerning specifications should be considered for inclusion in the SEMP:

—Increase emphasis on defining/refining the requirement.

—Evaluate requirements by affordability and trade-off analysis throughout acquisition cycle.

—Justify every specification before use.

—Tailor each specification to reflect needs of the program.

—Incorporate commercial specifications where appropriate.

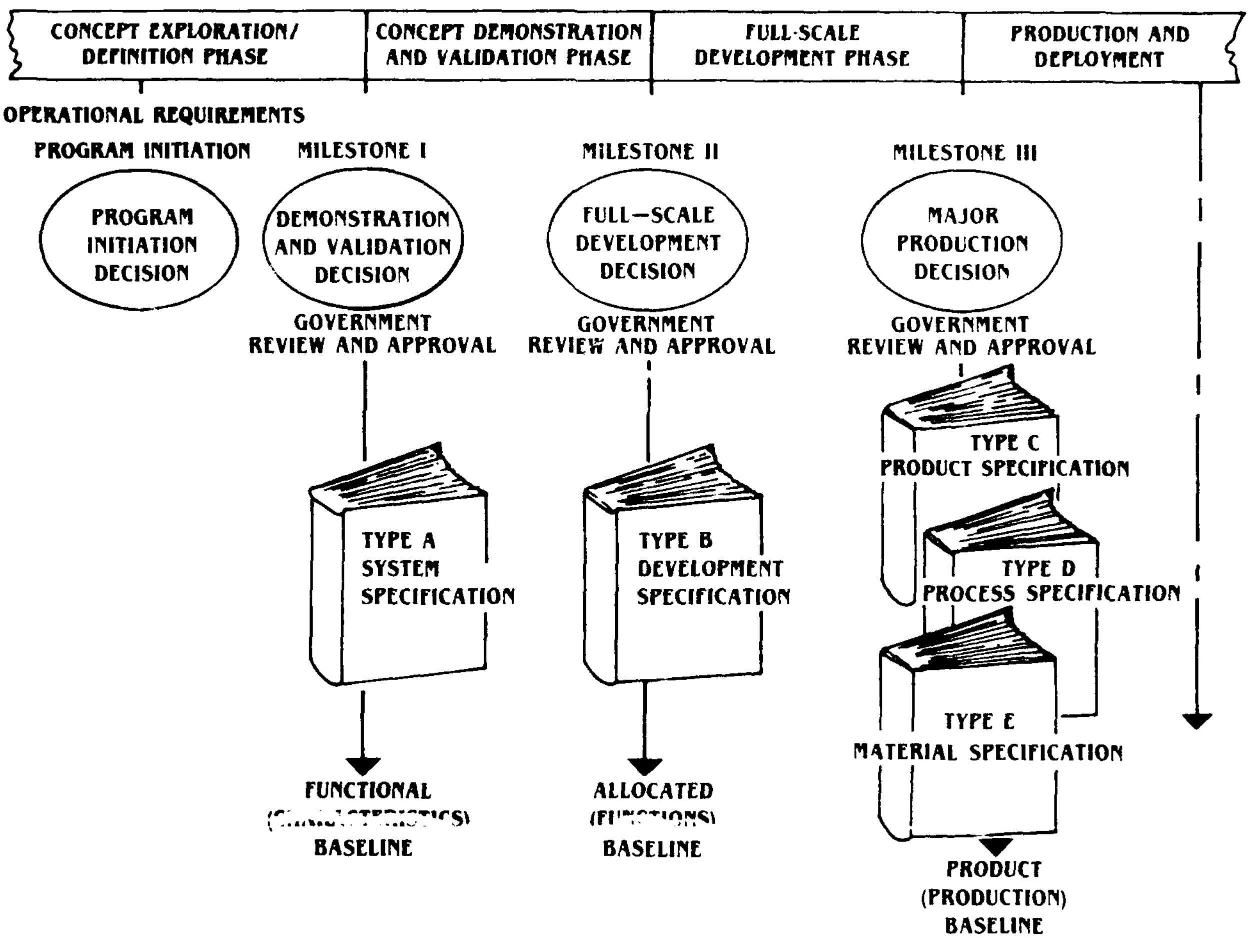
—Design qualification testing based on a components function and its mission success criticality.

—Use warranties prudently to guarantee performance and reliability, when cost effective.

—Increase emphasis on government/contractor interaction/communication.

Specifications are necessary for the successful development of complex systems and should be invoked, deleted or changed only after thorough deliberation by qualified personnel and consideration of benefits to the system development program. Each tailoring operation is unique for each program.

Figure 2. PROGRESSIVE DEFINITION OF SYSTEM SPECIFICATIONS



ATTACHMENT 1
SYSTEM SPECIFICATION CONTENT

Section (Title)	Contents
1 (Scope)	Briefly summarizes purpose and coverage of the document in a single paragraph. A brief overview of the intended application may be included.
2 (Applicable Documents)	Lists all documents identified and referred to in Sections 3, 4, and 5. References are applicable only to the extent specifically indicated in the location where they are referenced.
3 (Requirements)	Documents results of the system engineering process. Stated primarily in terms of functional and mission-related performance requirements. Design details should be stated on where they exist as constraints on the system.
3.1 (System Definition)	Provides brief description of the system, sufficient to permit understanding of application of the requirements set in 3.2.
3.1.1 (General Description)	Provides summary description of the system configuration, identifies functional areas (segments) into which the system is divided, and allocates CIs to the segments.
3.1.2 (Missions)	Provides description of the operational mission in which the system must perform, together with any bounds or constraints that would affect design.
3.1.3 (Threat)	Identifies potential man-made intentional threats or attacks which could prevent the system from accomplishing its mission.
3.1.4 (Interface Definition)	Includes the system specificaiton tree displaying the system hierarchy and the top-level functional block diagram displaying data flow segments. Functional flow diagrams are seldom appropriate here. Interface block diagrams may be appropriate if they expose more detail than is shown by the system block diagram. Text should be minimal.
3.1.6 (Government Furnished Property)	Identifies all hardware, software, and facilities provided by the government for the program.
3.1.7 (Operational and Organizational Concept)	Describes how the system will be deployed and operated to fullfill the mission. Describes organiza-

	tion established to manage system during its operation and interfaces with user organizations.
3.2 (Characteristics)	
3.2.1 (Performance Characteristics)	Contains all system level functional and performance requirements derived in the mission and functional analyses. Is most conveniently divided into major categories such as operating modes, quantity, quality, coverage, timeliness, control security, communication links, survivability, etc. Individual requirements can be stated in quantitative terms where possible.
3.2.2 (Physical Characteristics)	Contains only dimensional and mass limitations coordinate systems, alignment requirements, security, etc., which place constraints on overall system design.
3.2.3 (Reliability)	Defines total system reliability value and segment allocations.
3.2.4 (Maintainability)	Contains maintainability criteria imposed on system and any critical mean-time-to-repair values.
3.2.5 (Availability)	Contains availability criteria imposed on system.
3.2.6 (System Effectiveness Models)	Usually marked not applicable. System effectiveness items are covered in other paragraphs.
3.2.7 (Environmental Conditions)	Specifies all environmental conditions to which the system is subjected, whether during manufacture, transportation, or operation (ground, sea, air, launch, space, reentry) and includes threat environment, both intentional and unintentional.
3.2.8 (Nuclear Control Requirements)	Usually marked not applicable except where nuclear devices are employed.
3.2.9 (Transportability)	States any unique transportability requirements on the system.
3.3 (Design and Construction)	Contains most of the standard parts, materials, processes, safety, human engineering, and the engineering specialities and specifies requirements for systems containing computer programs. These requirements may include program structure, top-down design, structured coding, programming languages, etc.
3.4 (Documentation)	Specifies standards to which documentation should be produced.
3.5 (Logistics)	
3.5.1 (Supply)	[illegible] y specify levels of maintenance to be employed. It may reference the contrac-

	tor's maintenance plan.
3.5.3 (Facilities and Equipment)	Specifies requirements for new or modified facilities and auxiliary equipment. It may reference the contractor's facility plan.
3.6 (Personnel and Training)	Defines involvement of any personnel in terms of numbers and skill levels. Training requirements are usually defined in the contractor's training plan, which may be referenced here.
3.7 (Functional Area Characteristics)	Contains allocation of system requirements and provides basis for the segment specifications. In a preliminary document such as the general systems specification, this section may not exist if the allocation has not been performed. Where all segment specifications exists, they may be simply referenced here.
3.7.1 (Segment A Characteristics)	Contains the allocated Segment A performance requirements, physical characteristics and interface characteristics, based on the interfaces defined.
3.7.2 (Segment B Characteristics)	As in 3.7.1 above.
3.8 (Precedence)	Established order of precedence of this specification relative

	to reference documents.
4 (Quality Assurance)	
4.1 (General)	Defines test philosophy and references test standards to be employed.
4.1.1 (Test Responsibility)	Identifies organizations responsible for tests and locations where tests will be conducted.
4.1.2 (Classification of Inspections and Tests)	Defines verification methods.
4.1.3 (Verification Cross Reference Cross)	Provides listing of the test requirements with the method and level of final verification. It serves as basis for development of the system test plan.
4.2 (Quality Conformance Inspections)	Defines nature of testing to be conducted throughout program.
4.2.1 (Lowest Tier Quality Assurance Provisions)	Defines parts and materials testing.
4.2.2 (Engineering Design Verfication)	Defines any unique testing using engineering models, prototypes, or mock-ups.
4.2.3 (Qualification Tests)	Defines tests conducted to prove the design of equipment and components. Items are stressed above highest levels predicted for operational use. Usually conducted on the first article.
4.2.4 (Acceptance Tests)	Defines tests conducted on each arti-

	cle to prove workmanship. Items are stressed at, or above, normal operating environment.
4.2.5 (Service Life Verfication)	Defines life testing to be conducted, particularly on limited-life items.
4.2.6 (Pre-Deployment Tests)	Defines system tests to be conducted before operational use.
4.2.7 (Operational Tests)	Defines tests to be conducted after system is operational to provide final verification of system capability to meet requirements.
5 (Preparation for Delivery)	Provides guidance for preparation of equipment for delivery.
6 (Notes)	May contain definitions, abbreviations, acronyms, and other information useful in promoting an understanding of the system or its operation. The non-contractually binding material in Section 6 must not reference material in other contractually binding sections.
10 (Appendices)	Contains tailoring, environmental data, evaluation methodology, or other data which has too much detail for incorporation in the main body of the document. Appendices are contractually binding.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number 4.9
Version: Update
Date: December 1988

I. TITLE

System Safety

II. REFERENCES

—DODI 5000.36, "System Safety Engineering Management"

—MIL-STD-882, "System Safety Program Requirements"

—DSMC publication, *System Engineering Management Guide*

III. POINTS OF CONTACT

Director, Safety and Occupational Health
Office of the Assistant Secretary of Defense for Force Management and Personnel
The Pentagon
Washington, D.C. 20310
(202) 695-0110; AV 225-0110

Directorate of System Safety Policy
Headquarters, Air Force Inspection and Safety Center
Norton Air Force Base, CA 92409
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System Safety Division (AFSC/IGFS)
Headquarters, Air Force Systems Command
Andrews Air Force Base, MD 20334
(301) 981-5795; AV 858-5795

System Safety Division (AFLC/IGYS)
Headquarters, Air Force Logistics Command
Wright-Patterson Air Force Base, Ohio 45433
(513) 257-6007; AV 787-6007

Headquarters, Department of the Army
(DAPE-HRS)
The Pentagon
Washington, D.C. 20310-0300
(202) 695-7291; AV 225-7291

Non-Nuclear Munitions Safety Board
AD/SES
Eglin Air Force Base, FL 32542
(904) 882-4317/2429; AV 872-4317/2429

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Headquarters, US Army Materiel Command
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Alexandria, VA 22333
AV 558-6595

Commander Navy Safety Center
Naval Air Station
Norfolk, VA 23511
(804) 444-3494; AV 690-3494

System Safety (Code 09E)
Naval Air Systems Command
Washington, D.C. 20361
(202) 692-1238; AV 222-1238

Director, Safety Office (Code 06H)
Naval Sea Systems Command
Washington, D.C. 20362-5101
(202) 692-2080; AV 222-2080

Director, Safety Office (Code 09K)
Space and Naval Warfare Systems Command
Washington, D.C. 20363-5100
(202) 746-4098; AV 286-4098

IV. PURPOSE AND SCOPE

This fact sheet is designed to:
—Describe the concept of System Safety and its

relationship to the development process

—Describe the purpose and essential elements of a System Safety program plan

—Describe the analytical tools applied in the System Safety process

—Be general in scope.

V. POLICY

An integral part of the system engineering process, system safety engineering participates in, and supports, system development at the design decision level to ensure that the highest degree of safety and occupational health, consistent with mission requirements and cost effectiveness, is designed into DOD systems and facilities. The system safety program begins with the inception of the development program and continues throughout the life cycle.

VI. DEFINITIONS

—**Hazard**: A condition that can result in a mishap.

—**Mishap**: An unplanned event or series of events that result in death, injury, occupational illness, or damage to or loss of equipment or property.

—**Risk**: An expression of possible loss in terms of hazard severity and qualitative or quantitative likelihood.

—**Safety**: Freedom from conditions that can cause death, injury, occupational illness, or damage to or loss of equipment or property.

—**System Safety**: The degree of safety achieved by a system.

—**System Safety Program**: The combined activities and tasks of system safety management and system safety engineering.

VII. CONCEPT OF SYSTEM SAFETY

The concept of system safety is to (1) acknowledge the inherent hazards associated with weapon systems, (2) work to understand the requirement and the system in order to identify hazards, and (3) make decisions that will achieve a balance in the system that satisfies operational needs at a commensurate level of safety.

The essential elements of the system safety process include enlisting system safety expertise at the outset to help establish requirements; conducting continuous analyses to identify hazards and establish safety design guidelines; participating on the design team; and, contributing to test planning, analysis, and assessment.

VIII. RELATIONSHIP TO THE DEVELOPMENT PROCESS

In the early stages of development, the system safety engineer works closely with design engineers: he becomes familiar with design concepts and the operational requirements that drive those concepts. He brings principles of "design for safety" to bear on the design process, and evaluates different options from a safety point of view. He uses standard guidelines, engineering judgment, and past experience with similar system or subsystem concepts to point out possible areas of concern. He may help to establish certain rules, such as the definition of "safe separation," or certain details of the life cycle. Areas of concern are identified for further analysis or for testing.

As the design matures the system safety engineer performs specific analysis at the system and subsystem level of design. An analysis might investigate the effects of certain failure modes, for instance, or try to deduce what combination of events may lead to a certain undesired event. If the analysis suggests it is appropriate, specific tests may be performed at any time in the process. The overall purpose of such analyses and testing is to uncover design faults or weaknesses that are not otherwise obvious, or to identify specific logistics phases or even specific operations, during the stockpile-to-target sequence, where a hazard or hazards are especially present, and to recommend corrective action. Corrective actions take the form of design changes or, less preferably, the incorporation of special procedures.

For safety analyses to be valuable, intuition and experience should be the background upon which the analyst builds a logic-based, structured, and sufficient body of knowledge about the system from which to draw valid conclusions and make recommendations. The analysis, however, whether it is a technique like fault-tree analysis or a qualitative sub-system hazards analysis, is only a tool to aid in drawing conclusions. The usefulness of the tool depends on the skill of the analyst using it.

As the program reaches its developmental test and evaluation phase and the time for hazard-assessment testing, the safety engineer recommends tests to be performed that will examine specific hazards that he has identified, and that have not been resolved through analysis or by previous testing. Tests to evaluate specific hazard concerns identified by analysis, supplement any mandatory set of hazard assessment tests that may be performed on that system type. The safety engineer uses those test results as part of his final and summary assessment of the weapon system.

IX. SYSTEM SAFETY PROGRAM PLAN

The purpose of writing a system safety program plan is to document the results of a thoughtful assessment of how the SYSTEM SAFETY process should be applied to achieve the objectives of the weapon system development program. It can be useful in communicating, tracking, and evaluating the system safety program as it is executed.

The essential elements of the system safety program plan include:

a. Planned safety tasks
b. Organizational responsibilities
c. Methods of accomplishment
d. Milestones
e. Depth of effort
f. Integration with other program activities.

X. ANALYTICAL TOOLS OF SYSTEM SAFETY

The application of the analytical tools of system safety is an engineering activity intended to provide insight for decision-making. The analyses will identify hazards, conditions that could lead to a mishap, and the potential consequences of a mishap. This information along with other performance, cost, schedule, and support data will provide the basis for deciding what to do about the hazard. The breadth and depth of the analyses must be appropriately scoped to meet program needs.

The analyses that normally are applied may be either qualitative or quantitative and include the following:

a. *Preliminary Hazard Analysis* to identify safety critical areas, evaluate hazards, and identify the safety design criteria.

b. *Subsystem Hazard Analysis* to identify hazards associated with component failure modes and functional relationships of components and equipments comprising each subsystem.

c. *System Hazard Analysis* to identify hazards at the system level by focusing on subsystem and system interfaces.

d. *Operating and Support Hazard Analysis* to identify hazards and determine safety requirements for personnel, and equipment interfacing with the system throughout the operating and support cycle.

e. *Fault Hazard Analysis* to determine component/subsystem hazard modes, causes of those hazards, and resultant effects to the subsystem/system.

f. *Fault Tree Analysis* to identify all events, faults, and occurrences, and all their combinations, that could cause or contribute to the occurrence of a defined undesired event.

g. *Sneak Circuit Analysis* to identify latent (sneak) circuits and conditions that inhibit desired functions or cause undesired functions to occur, without a component having failed.

There are other analyses that may support the system safety effort. They may be performed by the safety engineers or other disciplines such as a Failure Modes and Effects Criticality Analysis, which may be performed by the reliability engineers. The important point is that the system safety effort must be a fully integrated part of the engineering effort with access and understanding of all aspects of the program.

As hazards are identified and understood they should be included as part of an overall program risk assessment. The risk assessment can be a straightforward ranking based on a qualitative analysis of a matrix of hazard severity and likelihood. The MIL-STD-882 defines hazard severity categories as follows:

a. *Category 1—Catastrophic*, may cause death or system loss

b. *Category 2—Critical*, may cause severe injury, severe occupational illness, or major system damage

c. *Category 3—Marginal*, may cause minor injury, minor occupational illness, or minor system damage

d. *Category 4—Negligible*, will not result in injury, occupational illness, or system damage.

The assignment of a likelihood of occurrence to any specific hazard is more difficult than estimating the category of potential damage, and is not specifically defined by MILSTD 882. However, the following qualitative example is provided:

a. *Frequent*, likely to occur frequently

b. *Reasonably Probable*, will occur several times in life of an item

c. *Occasional*, likely to occur ometime in life of an item

d. *Remote*, so unlikely, it can be assumed that this hazard will not be experienced

e. *Extremely Improbable*, probability of occurrence cannot be distinguished from zero

f. *Impossible*, physically impossible to occur.

The categories and likelihoods can be built into a matrix of cells. Each identified hazard will fit in one of the cells and a prioritization of hazards can then be established. For example, hazards in cell a-a, catastrophic and frequent, must be resolved. Each subsequent cell can be assigned a priority and level of review for resolution. This methodology helps structure the problem to help management understand the situation and focus emphasis. It is important to understand that building this matrix requires the exercise of good judgment—it can in no way substitute for good judgment!

XI. SUMMARY

Achieving an appropriate level of system safety requires an organized approach to identify, eliminate, and control hazards. The order of precedence for doing this is design first; add devices second; and, use procedural solutions only when the hazard cannot be adequately controlled by one of the first two steps.

The identification of hazards process is, by definition, seeking to expose "problems" that must be resolved and, therefore, could be misconstrued as negativism. It is necessary that judgment and integrity characterize the process to ensure the program manager receives valid information that he can confidently use in making decisions that balance risk and requirements in achieving the system objectives.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 4.10
Version: Original
Date: March 1988

I. TITLE

The Essentials of Program Reviews

II. REFERENCES

—*Software Engineering Economics*, Prentice-Hall, Inc., 1981

The Implementation of Project Management: The Professional Handbook, Addison-Wesley, October 1981

—*The Technical Program Managers Guide To Survival*, John Wiley and Sons, Inc., 1967

—*Systems Engineering Management Guide*, Second Edition, Defense Systems Management College, December 1986

—*Manufacturing Management Handbook*, Second Edition, Defense Systems Management College, July 1984

DODI 5000.2, "Defense Acquisition Program Procedures," 1 September 1987

—MIL-STD-1521B, "Technical Reviews and Audits for Systems, Equipments, and Computer Programs"

—MIL-STD-499A, "Engineering Management"

III. POINT OF CONTACT

—Technical Management Department (SE-T) Defense Systems Management College, (703) 664-6818

IV. PURPOSE AND SCOPE

This fact sheet is designed for use as a practical guide for status program reviews that are held between the government Program Management Office (PMO) and the contractor. The material introduces the program manager (PM) and his/her staff to program review happenings and activities. Various types and purposes of reviews will be discussed as well as the activities preparing for and during the reviews.

V. POLICY

Department of Defense policy statements on the conduct of non-technical or progress reviews are almost non-existent. The format and evaluation are left entirely up to the PM and the peculiarities of the program. The DOD recognizes that reviews are essential for providing progress assessments which, in turn, lead to mutually beneficial decisions to be made on the program. The review serves the government and contractor needs and, as such, should be jointly chaired with open discussion, shared data, and a team relationship fostered. Sequence and timing of non-technical reviews for each program shall be tailored to the system under development at the discretion of the PM.

VI. DISCUSSION

—Introduction to the Review Process: Reviews require the application of substantial PMO and contractor resources. While receiving a positive return on this investment is a challenge to every PM, the periodic review of program status proved essential to timely and knowledgeable decisions saving time, effort and cost.

The PM and staff monitor the contractor's efforts to assure that progress happens in accordance with the master program plan. The entire PMO must be knowledgeable of ongoing and upcoming activities in each respective area of responsibility. This can only be accomplished with reliable data, personal

visits and interchanges to assure the situation is accurately assessed. The program review is the best vehicle to accomplish this.

—Purpose of a Program Review: The program is reviewed to assess the status of the program's progress in cost, schedule and technical performance. The objective is to assure that scheduled activities are completed, to highlight problem areas causing delays in the program, and to determine what courses of action are necessary to resolve problem areas. It is an opportunity for a face-to-face encounter between the PMO and the contractor to promote common understanding of program requirements. The review provides a forum for an information exchange and allows the PM to effectively evaluate contractor progress.

The program review must cover, in summary form, past monthly reports, upcoming milestone plans and actions, and any unresolved and open areas of concern. The PM should insist that contractors present data satisfactorily supporting their conclusions. Any variance or discrepancy should be questioned. All action items for resolution should become part of the review minutes.

—Types of Program Reviews: The two basic types of program reviews are technical and non-technical. Technical reviews are formal engineering meetings as defined in MIL-STD-1521B and are discussed in Fact Sheet 4-1. Non-technical reviews are often referred to as program manager reviews or program reviews. For purposes of this fact sheet, these will be referred to as program reviews.

There are several types of non-technical reviews. Formal program reviews are normally held at key milestones in the progress of the program and can include participants from any number of concerned agencies. They are usually held for government assessment, cover program milestones, and provide constructive appraisals of program progress and completions. These reviews are part of a cohesive review program tailored to the specific needs of the system under development, production and/or deployment. These reviews are usually held on a quarterly basis and normally conducted at the contractor facility.

—The Review: The PM must approach the review as a chance to exchange information and communicate with the contractor. An understanding of the review requirements and the need for preparation are paramount for a successful program review. The PM, staff, and contractor need to do homework before participating in a program review. The following is a list of conditions upon which program reviews should be based:

—Know what is required, what must be accomplished and what was accomplished during the review period

—Determine whether something is under control; ask the right questions

—Provide analyses/evaluations pertinent to the review

—Evaluate solutions and their impact on the programs

—Never lose sight of unanswered questions. Assign appropriate actions to resolve the issues.

Routine day-to-day and month-to-month program status is normally determined through the written reports provided by the contractor monthly. Evaluation of material in these reports usually depends on the interpretation and experience of the reader. The written periodic report should usually be supported by some other source of program progress evaluation such as a plant visit or an area walk-through. Reviewing only monthly reports and other supplementary information may not provide the level of knowledge needed for control. Research activities should include a review of the most recent monthly reports including progress, technical, test, cost, etc.

No two reviews are conducted the same way. The PM must assure that the contractor will provide pertinent and complete information. Perhaps the most important portion of a review is setting the agenda. The agenda is usually jointly developed by the PMO and the contractor to assure both parties have their subjects included. The final agenda is subject to PM approval. The general rule of thumb would be to initiate an agenda for the forthcoming review approximately 30 days prior and have an approved agenda no later than 10 days prior to the planned reviews.

An important agenda item is the status of open action items. Action items establish the effectivity of previous discussions and keep identified problems highlighted. The body of the review is conducted providing detailed status and position. The review is then brought to a close with a summary.

closure, and updated action item list. Program review agendas should be prepared and precoordinated for every review that is conducted.

The contractor should maintain a complete set of program master schedules. The near- and far-term milestones become the basis of status and progress discussion. It is recommended the contractor maintain a series of schedules on a "gross" and a "detailed" level. The gross schedule should include the entire program with both important contractor and government milestones. These milestones should include not only items germane to program events but, also, formal program reviews, all initial delivery actions (both customer and GFE), all test starts and completions, major documentation deliveries, etc. The program schedule should be presented during each review.

The contractor should also maintain detailed schedules covering a period of at least the next 12 months of progress. This same schedule should cover the period from the last review to the current review to allow program assessment of events that were supposed to happen. This schedule should be at the same level of detail as the Work Breakdown Structure (WBS) and/or the Cost Schedule Status Report (C/SSR) management system. It is important that the schedule provides enough insight into the future to allow for adequate corrective action time and to clearly delineate both contractor and government responsibilities, actions, and events.

The minutes of the meeting should contain the listing with the following data included:

—The action item stated as simply as possible

—The responsible agent or individual to accomplish the action identified (an organization name is not sufficient without an individual's name)

—A suspense date.

The number of attendees at a program review can easily become excessive. Typically, government personnel are there because of a perceived need or to establish status. If the individual can make a contribution, then he/she should attend. Too often attendees are simply observers and never challenged.

Establishment of an attendence ceiling for the meeting is strongly recommended. If someone arrives without the necessary preparation, his/her attendance should be challenged. If an attendee sits through the meeting without contributing, a challenge should also be levied. Making the trip to the contractor plant represents a significant investment of time, salary and travel money. The PM, as the senior government representative, should look at the cost to the government and see if the net contribution is justified.

VII. SUMMARY AND REVIEW

The PM and every PMO staff member should be familiar with the accomplishments since the last review and the accomplishments required for the next review. Every member attending the review should ensure that the data presented and their potential impact is understood. Each individual must be able to determine that a variance or a discrepancy exists and be forceful enough to insist on an understanding.

There must be continual program review analysis to ensure that requirements are real, that the task or effort identified is achievable and measurable, and that alternative ways to accomplish the tasks have been thoroughly evaluated. The PM must never lose sight of the goal. A close, efficient team relationship must be maintained with the contractor while remaining objective. The PM must make honest assess the program avoid "not merely hearing what he wants to hear but accepting as fact the truths that will cause him grief!"

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number 4.11
Version: Update
Date: December 1988

I. TITLE

Configuration Management

II. REFERENCES

—DOD 5010.19, "System Safety Engineering Management"

—Joint DOD Services and Agencies Regulation, "Configuration Management"

—DOD-STD-480B, "Configuration Control-Engineering Changes, Deviations and Waivers"

—MIL-STED-481B, "Configuration Control—Engineering Changes, Deviations and Waivers (Short Form)"

—MIL-STD-482A, "Configuration Status Accounting Data Elements and Related Features"

—MIL-STD-483A, "Configuration Management Practices for Systems, Equipment, Munitions and Computer Programs"

—MIL-STD-490A, "Specification Practices"

—MIL-STD-1521B, "Technical Reviews and Audits for System Equipments and Computer Programs"

—*Systems Engineering Management Guide*, Defense Systems Management College, Chapter 11

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IV. PURPOSE AND SCOPE

This fact sheet is designed to:

—Describe Configuration Management (CM) and its four basic functions of identification, control, status accounting, and audits.

Describe the three standard configuration baselines, when they are established and the concept of baseline management.

Be general in scope (i.e., service-unique policies and practices are not stressed herein).

V. POLICY

It is the policy of the Department of Defense (DOD) to apply configuration management to ensure operational efficiency and control cost, and to achieve uniformity in CM procedures and practices within the Department of Defense and between DOD and industry.

Specific policy for application of CM is as follows:

—The degree of CM applied for an item shall be appropriately tailored to be consistent with the complexity, size, quantity, intended use, mission criticality, and life-cycle phase of the item.

—Appropriate DOD CM of interface baseline characteristics shall be applied to any developmental item, before approval for Full-Scale Development (FSD) (Milestone II) if the item is required to interface with specified Configuration Items (CIs) under development, in production or in supply; or, if the item is required to be compatible with an existing or planned maintenance program.

—Appropriate DOD CM shall be applied to any item to be developed wholly or partially with government funding, immediately following approval for the FSD phase (Milestone II).

—For CIs wholly developed with private funding and procured by the government, appropriate CM shall be applied to the configuration baseline when the procurement is initiated.

—During the deployment/operation/support phase, appropriate CM shall be continued to the extent required for readiness support.

VI. DEFINITIONS

—Baseline. A document or a set of documents formally designated and fixed at a specific time, which constitute the approved configuration identification. Documents usually refer to specifications and drawings for hardware and, for software, may include listings, flow charts, decision trees, etc.

—Configuration. The functional and physical characteristics of material as described in technical documents and achieved in a product.

—Configuration Item (CI). An aggregation of hardware/software designated by DOD components for CM. The CIs may differ widely in complexity, size, and kind. Examples are an aircraft, ship, mobile test unit, navigation system, embedded computer, computer program, facility, electronic system, test meter, or a round of ammunition. During development and initial production, CIs are those specification items whose functions and performance parameters must be defined and controlled to achieve the overall end use function and performance. MIL-STD-483 contains criteria for use in selecting CIs.

—Configuration Management. The engineering management process that includes the following functions (or elements).

1. *Configuration Identification.* Selection and maintenance of the documents which identify and define the configuration baseline characteristics of an item. This element is very similar to a technical library function (MIL-STD-483, MIL-STD-490).

2. *Configuration Control.* Controlling changes to the configuration and its identification documents. A major function of this element is the administering of the Configuration Control Board (DOD-STD-480, MIL-STD-481).

3. *Configuration Status Accounting.* Recording and reporting the implementation of changes to the configuration and its identification documents. This element is primarily a management information function (MIL-STD-482).

4. *Configuration Audit.* Checking an item for compliance with the configuration identification. This element conducts the Functional and Physical Configuration Audits (FCA and PCA) (MIL-STD-1521).

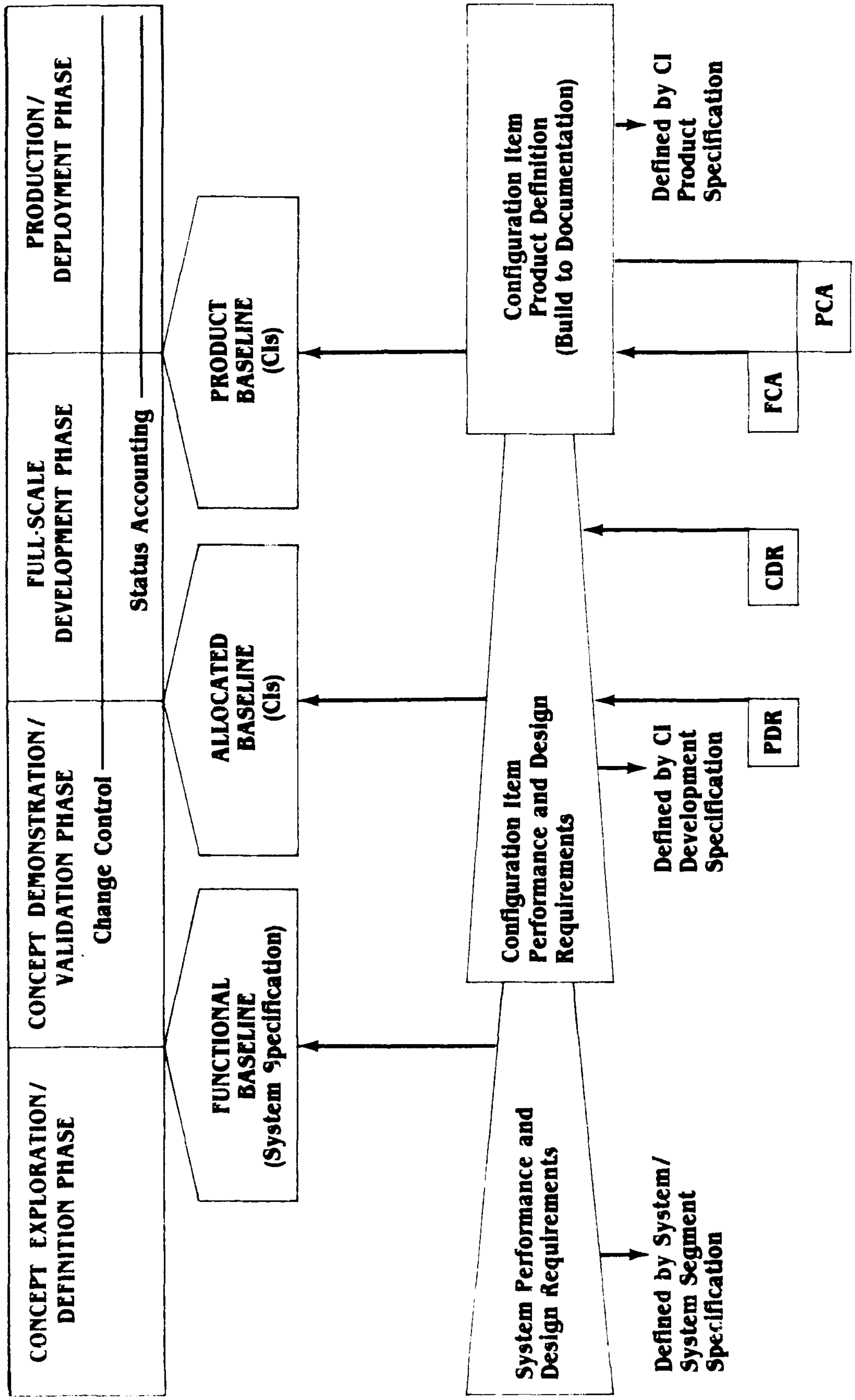
VII. BASELINE MANAGEMENT

The concept of baseline management was developed to provide the government and its contractors with a framework for documenting the progressive definition of a given system and a method for measuring accomplishments of the systems acquisition program. In systems management, baselines and ground rules are laid out beginning with the system specification (Type A). This specification establishes the basic system requirements against which allocations can be made to CI development specifications (Type B) and progress evaluated as a system definition evolves through design, fabrication (coding) and test. These baselines serve to chart the course against which future progress and actions (changes) can be evaluated. The contractor should document his plan for implementing this concept in a government-approved CM Plan (MIL-STD-1456).

A baseline designation implies the government has formally approved a set of requirements. There are three formally identified baselines in military (DOD) programs (see Figure 1). The three baselines are:

—Functional
—Allocated
—Product.

Figure 1. CONFIGURATION MANAGEMENT BY BASELINE



—Functional Baseline. The Functional Baseline should be established at the end of the Concept Exploration/Definition (CE/D) Phase; but normally occurs at the end of the Concept Demonstration Validation (CD/V) Phase. The Systems Specification (Type A) (or Development Specification, Type B, for smaller programs) defines the technical portion of the program requirements. Normally, this initial System Specification is included in the Request For Proposal and provides the basis for contracting and controlling the system design. It is the foundation for CM during the subsequent phases of the program. Once the System Specification has been approved at the System Design Review during the CD/V phase, the Functional Baseline is established and formal configuration control initiated. This baseline should be established by or at the System Design Review.

—Allocated Baseline. The second baseline is the Allocated Baseline. This baseline is developed progressively, CI by CI. It consists of approved Development Specification(s) (Type B) which define(s) the performance requirements for each CI. It is normally established during the FSD phase and incorporates the technical approaches developed to satisfy the objectives in the Functional Baseline. During the CD/V phase and early FSD phase, these objectives are translated through the systems engineering process into subsystem and CI performance requirements. Initial Development Specifications are usually included in the Request for Proposal for FSD. The Allocated Baseline is the basis for detailed design and development during the FSD phase. This baseline should be established by Preliminary Design Review but not later than Critical Design Review.

Note: Establishing the Allocated Baseline too early (such as arbitrarily tying it to FSD contract award date) will artificially restrict the contractor(s) design solutions, causing costly changes downstream.

—Product Baseline. The Product Baseline is established by the detail design documentation for each CI. The Product Baseline establishes the requirements for hardware fabrication or software

Figure 2. CONFIGURATION MANAGEMENT PLAN FORMAT

SECTION 1, ORGANIZATION: Describes the program organization, the composition, authority, and responsibilities of the CCB and other organizations involved in change processing and control, and the duties and responsibilities of the CMO.

SECTION 2, CONFIGURATION IDENTIFICATION: Identifies specifications to be prepared and the applicability of MIL-STD-490 and MIL-STD-483 to them. Defines drawing practices to be employed and the application of DOD-D-1000 and DOD-D-STD-100.

SECTION 3, CONFIGURATION CONTROL: Defines policies, procedures, and forms to be used in processing changes to established configuration identification. Application of DOD-D-STD-480, MIL-STD-481, and MIL-STD-483 shall also be defined.

SECTION 4, CONFIGURATION STATUS ACCOUNTING: Describes method for tracking and statusing each job package, configuration identification document, and change package. Defines method for maintaining the as-designed records and hardware/software as-built status. Implementation of MIL-STD-482 shall also be defined.

SECTION 5, SUBCONTRACTOR/VENDOR CONTROL: Defines application of CM methods to lower tier suppliers, conducting of audits and surveillance, and approach to product acceptance.

SECTION 6, PROGRAM PHASING: Defines milestones for major CM activities, including establishment of the CCB, implementation of specifications and interface control documents, and establishment of configuration identification, index, and status accounting procedures.

SECTION 7. MANAGEMENT INTEGRATION OF CM: Describes integration of CM with data base management, work breakdown structure, scheduling, and cost control activities.

SECTION 8, CONFIGURATION AUDITS: Defines the support to, and method of conducting, the FCA and the PCA.

coding and delivery. This baseline is developed progressively, CI by CI, as the initial article of each item is reviewed and approved by the government as satisfactorily meeting the specification requirements. This baseline will normally include specification types C, D, and E, engineering drawings, and related data as necessary to provide acceptance of an item without further development work. The Product Baseline is established initially by approval of the initial product specifications and then verified at the factory door on the first article of the CI series (FCA/PCA). The CI product baseline is the basis of the production Request for Proposal and subsequent Statement Of Work (SOW).

VIII. THE CM PLAN

Usually, a CM Plan is required on major system acquisitions, to be submitted either with the FSD phase proposal or early in the FSD phase. Plan content is outlined in MIL-STD-1456 and in Figure 2.

FACT SHEET PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 4.12
Version: Original/Current
Date: December 1988

I. TITLE

Technical Data Package Validation

II. REFERENCES

—DOD Directive 4245.6; *Defense Production Management*

—DSMC Program Manager's Notebook; Fact Sheet 6.2.2, "Establishing Competition"

—DSMC Program Manager's Notebook; Fact Sheet 6.6, "Configuration Management"

—DOD-D-1000; *Drawings, Engineering and Associated Lists*

III. POINTS OF CONTACT

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IV. PURPOSE AND SCOPE

The purpose of this fact sheet is to provide the program manager with guidance on achieving risk reduction in the competitive acquisition of production hardware through technical data package (TDP) validation.

This fact sheet is designed to:

—Describe TDP validation as it relates to risk reduction in the transfer of detailed design data from one contractor to another

—Present alternate TDP validation methods and associated risks

—Discuss additional validation considerations.

V. DOD POLICY

"Technical data packages shall be developed and proven by means of production demonstration and configuration audit, consistent with competition, component breakout, and reprocurement objectives." (Ref.: DOD Directive 4245.6)

VI. TECHNICAL DATA PACKAGE VALIDATION IN SUPPORT OF COMPETITIVE ACQUISITION

Technical data package validation is the controlled process by which technical data are certified as acceptable for the support of configuration-controlled, low-risk, competitive procurement of military equipment. Although TDP validation could be applied to major systems, it is more frequently applied to less-than-major systems or subsystems and at the major component (equipment) level. Validation should be performed when competitive production acquisitions are planned using a detailed design disclosure TDP (Ref.: DOD-D-1000 Level 2 or Level 3) with the intent to obtain exact duplicates of a system, subsystem or equipment.

TDP validation also should be performed when a system or major component is developed by a government facility or is "broken out" from contractor furnished equipment (CFE) to government furnished equipment (GFE) with the intent to initiate follow-on competitive procurement.

Many DOD procurements include provisions for delivery of technical data and rights to the procuring activity. Procurement of a detailed design disclosure TDP, along with unlimited rights in technical data, is generally required when follow-on competitive procurements of equipment or spare parts (where parts interchangeability is desirable) are planned. The TDP should conform to DOD-D-1000, Level 3, requirements. However,

if only a Level 2 data package and data rights are available, validation by competent government personnel can provide an upgrade of the TDP to Level 3.

The TDP delivered to the government by the developer should be representative of the product baseline and should be of sufficient detail to permit duplicate fabrication by any competent commercial source without additional investment in design or development. However, experience indicates that production problems will always occur if the data package is used as delivered. Potential errors, omissions, inaccuracies or non-disclosures in the unvalidated TDP pose cost, technical and schedule risks if used in follow-on competitive acquisition. Liability for discrepancies and omissions in the TDP which are discovered by a new contractor attempting to use the unmodified TDP shifts from the developing contractor to the government.

In order to minimize the risk and impact associated with this liability, a team of skilled government technical personnel can be used to validate the TDP prior to, or in parallel with, the competition process. After validation, this engineering team can provide the "hands on" expertise required for the technical management of the competitive contracts and for problem resolution and product improvement during the life of the program. Having this expertise available to resolve difficulties encountered by a new production source or in contractual disputes over the TDP can significantly reduce program costs and schedule risks. In addition, once the TDP is validated by this independent team of experts, the vehicle is in place to sustain competition for production units and spares throughout the equipment life cycle.

VII. VALIDATION METHODS

Validation can reduce the level of risk associated with a TDP such that the probability of successful fabrication by a competitive source is extremely high. Validation methods range from the desk-top audit (a validation method only applicable to very-low complexity items) to a complete "build-to-print" validation applicable to very complex end-items.

To effectively minimize risks in follow-on competitive procurements, it is essential that the program manager select a validation methodology compatible with the level of technical complexity of the equipment under consideration. The various validation methods may be tailored and/or combined to satisfy individual program requirements.

The most common methods of TDP validation are summarized as follows:

A. DESK-TOP AUDIT—A desk-top audit (DTA) typically consists of a detailed review of the original producer's TDP to ensure that the drawings are accurate, complete, describe an end-item, and conform to the format and content requirements of the applicable specifications and standards. As a minimum, a *complete and thorough* DTA consists of:

—Assuring that documentation exists for all component parts, subassemblies, and end items

—Assuring that documentation conforms to DOD-D-1000 requirements

—Identifying sole source, proprietary, and patented items, if documented

—Performing a tolerance analysis to ensure that parts manufactured to permissible tolerance extremes fit together

—Reviewing material and finish requirements for completeness

—Reviewing adequacy of inspection/quality requirements

—Identifying restrictive/proprietary processes, if documented

—Reviewing components for potential obsolescence, high-risk technology, or limited availability.

Performance of a desk-top audit, however, does not ensure that the end-item is producible, will meet performance specifications, or that it will function as required. A TDP validation using only a desk-top audit should be limited to very simple parts/devices such as machined parts, cables, or low-complexity assemblies. For most military equipment this method *is not* a suitable validation approach.

B. CONFIGURATION AUDIT REVIEW (CAR)—A CAR is preceded by a DTA and consists of examination, test, teardown, and comparison of equipment components and subassemblies to the TDP re-

quirements. A CAR is usually conducted by/at an independent (government) agency. Contractor personnel, if involved in the audit process, only provide tools, equipment or other auxillary support. The equipment teardown may be either destructive or non-destructive (as specified by the cognizant government program manager), and may include build-up and retest of the equipment sample (in the case of a non-destructive audit). *A complete and thorough* CAR will typically identify physical design anomalies and provide verification that:

—Piece part dimensions are within the limits detailed on the drawings

—Workmanship matches that described on the drawings

—Materials and finishes comply with drawing requirements

—Part numbers and locations comply with drawing details

—Functional tests demonstrate performance to specification (test) requirements

—Fabrication and assembly of units is in accordance with specifications.

The CAR provides assurance that the sample of the contractor's equipment complies with the TDP requirements (or conversely, that the TDP describes the sample of the contractor's equipment). It does not, however, validate unique or undisclosed manufacturing processes and procedures that must be used to successfully produce the product, nor does it provide a large enough sample of equipments to assure general compliance of all hardware to TDP requirements.

C. BUILD-TO-PRINT VALIDATION—This method consists of a DTA followed by the manufacture and test of a limited quantity of equipments. The actual manufacture and test of a meaningful number of equipments, under strictly controlled conditions and by a source other than the original manufacturer, is the only validation method that will conclusively prove that the TDP is adequate to support low-risk, competitive procurement. This validation method demonstrates that:

—Materials and parts can be obtained competitively from multiple sources

—Specifications/procedures are adequate to inspect and test incoming parts and materials

—Each subassembly can be fabricated, tested and integrated into the next-higher assembly

—Manufacturing process and other design disclosure information are adequate to fabricate complex devices, such as hybrid microcircuits

—Factory tooling and test equipment hardware and software can be designed/fabricated to adequately assemble and test the equipment to specification requirements

—Mandatory processes not contained within the data package have been identified, developed, and documented

—Subassemblies and final assemblies meet specified physical dimensions

—Subassemblies have adequate requirements, both dimensional and functional, to assure that end-item functional requirements can be met with reasonable yields

—End-items produced will meet manufacturing acceptance tests.

D. COMBINATION OF METHODS—This approach consists of selectively applying the above validation methods to various assemblies, subassemblies, and components within a system depending on the technical complexity and manufacturing risk associated with each part/subassembly/assembly. I also can include a real-time audit of the contractor along with selective assembly/test of a meaningful number of contractor furnished parts/subassemblies to prove that the contractor has supplied data that represent his processes, tooling, procurement abilities, etc. This approach can be applied when the cost or schedule requirements for a complete "build-to-print" validation do not prove to be economically prudent. Using such a method on extremely complex systems, subsystems or equipment, however, may result in unacceptable risk in a competitive reprocurement.

VIII. VALIDATION CONSIDERATIONS

Decisions regarding a validation strategy should be made early in the equipment acquisition cycle and included in the acquisition strategy and/or plan. Decisions regarding what technical data to procure, the validation schedule and the competi-

tion strategy (one time buy up, annual competition, etc.) to be used, all influence the cost of developing a competitive source, as well as the cost to validate. For example, procurement of stable base master artwork and phototools for printed wiring boards, factory test equipment documentation, and test requirements and procedures as a part of the TDP may considerably reduce the costs to duplicate these items by the validation activity, or by the competitive source. These items are not automatically provided as part of a DOD-D-1000 Level 2 or Level 3 TDP and therefore must be specified in the contract data requirements list. Designation of agency design series and part numbers, as opposed to contractor-assigned part numbers and design series, will reduce the configuration management burden brought on by competition. Establishment of a government team of technical experts to perform the validation effort will allow the program manager to provide assistance to the competitive source, establish long-term corporate memory, provide configuration management and control, and provide for implementation of product improvements. Contractual arrangements made with the developing contractor for validation support will assist in resolving TDP deficiencies identified during the validation process and in providing design disclosure information that has been determined to be missing or incomplete by the validation activity. These contractual arrangements, along with the procurement of data rights and a TDP, should be included in the request for proposal as priced options starting with the full-scale development (FSD) contract and should continue to be included in each subsequent procurement action.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 4.13
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I. TITLE

Value Engineering

II. REFERENCES

—Federal Acquisition Regulation, Part 48, "Value Engineering" and Part 52 248, "Value Engineering"
—DOD Directive 4245.8, "Value Engineering"
—DOD Handbook 4245.8-H, "Value Engineering"
—*Legal Times*, page 17, 12 April 1982, Tax Court ruling on VECP
—MIL-STD-1771, "VE Program Reporting"

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IV. PURPOSE AND SCOPE

This fact sheet is designed to:

—Provide information on the definition of value engineering

—Discuss cost savings through use of value engineering

—Be general in scope and provide information for all users

—Provide information on benefits when using value engineering.

V. DOD POLICY

It is DOD policy to promote VE actions that will reduce cost and improve the productivity of DOD in-house and contractor resources. In-house VE actions result in a value engineering proposal (VEP) submitted by DOD personnel as a result of their use of VE techniques. Such a VEP identifies improvements that have a net reduction in life-cycle costs to DOD

Government agencies:

—Are to provide contractors financial incentives by use of value engineering change proposal (VECP) contract clauses to search for and submit VECPs

—May require incorporation of value engineering clauses in certain subcontracts to encourage subcontractors to submit VECPs

—Are to provide contractors objective and quick processing of submitted VECPs and a fair share of the savings on those accepted

Value engineering payments do not constitute profit or fee within the limitations imposed by law.

VI. BACKGROUND

Typically, the government saves $500M/year on contracts—well-documented technical and cost savings. In addition, the in-house program typically saves $2B/year, for a grand total of $2.5B every year!

Still, pressure has been increasing in the government to cut costs and be even more cost effective. Traditionally, VE started in the DOD as an in-house program. It was necessary to develop sharing incentives with DOD contractors to get them to practice VE in their plants on DOD procurements. The split between in-house VE savings and contractor VE savings has been 70 percent versus 30 percent of total DOD VE savings.

In 1983 a General Accounting Office report determined that the DOD had not taken full advantage of value engineering. Now, DOD is aggressively seeking implementation of the value engineering clauses.

VII. DEFINITIONS

—**Value Engineering.** An organized effort directed at analyzing the functions of systems, equipment facilities, services, and supplies to achieve essential functions at lower cost with the required performance.

Value Engineering Change Proposal. This proposal requires a change to the instant contract to implement, and results in reducing the overall projected cost to the agency without impairing essential functions or characteristics.

—**The VE Proposal (VEP).** A specific change submitted by DOD personnel as a result of their use of VE techniques. The term also is used for a change submitted by contractor personnel that does not require implementation of a contract change.

—**The VE Task Teams.** Teams of professionals who specialize in engineering, production, procurement, management and estimating and who are organized to develop and submit VE proposals on high-cost areas to the appropriate decision-making authorities. Normally, they are led by a value engineer or a person trained in VE. Such teams may be DOD personnel, contractor personnel or a mixed team to address specific areas of interest.

VIII. SHARING VECP SAVINGS

Two basic types are acquisition and collateral savings.

—**Acquisition Savings.** Obtained on instant contract, concurrent contracts and future contracts.

—*Instant Contract.* The VECP is submitted under this contract. Savings are calculated based on contractor development and implementation costs, and government implementation costs.

—*Development Costs.* Incurred after contractor decision to prepare VECP, prior to government acceptance.

—*Implementation Costs.* Incurred in implementing the change after the VECP has been approved.

—*Concurrent Contracts.* All contracts for essentially the same item from the same contracting office which accepted the VECP. The originating VECP contractor receives a substantial share of all net savings, when the contracting office directs the VECP be incorporated into those other contracts.

—*Future Contracts.* Savings can be shared in one of two ways:

—*Lump-Sum Method.* Calculate expected savings over the next 3 years and add contractor share to the instant contract.

—*Royalty Method.* Contracting office incorporates the VECP on future contracts for the next 3 years. Originating contractor keeps records and invoices the contracting office for payment.

—**Collateral Savings.** Measurable net savings in operation, maintenance, logistics, shipping or GFP, as a result of the accepted VECP. The contractor gets 20 percent of the savings realized during a

typical 1-year period, not to exceed $100,000 or the value of the instant contract, whichever is greater.

IX. VALUE ENGINEERING CHANGES

Value engineering is the formal process by which contractors may either voluntarily make suggestions or be required to examine products for engineering changes that will yield a net savings to the government. There are two approaches to shared savings as shown in Figure 1. One is an incentive approach that is voluntary and the contractor, by using his own resorces, is given a larger share of the achieved savings. The other approach is to require contractually the establishment of a VECP program as a line item in the contract. The program effort is paid by the government and, consequently, yields a lesser reward to the contractor. The contractor's share of net acquisition savings under the two conditions is spelled out in the Figure 1. Note the change of sharing with the different types of contracts. Not stated in the chart is the limitation of collateral savings, such as the elimination of a government maintenance team. That sharing is 20 percent of the savings to the contractor but is not to exceed the contract cost or $100,000 whichever is greater.

Value engineering can be a multimillion dollar cost reduction and profit opportunity for industry. It can be a significant source of savings for the government. The VECPs may be applicable to costs directly involved with a deliverable product, or service or cost indirectly associated with company products. These could be changes in procedures, services, or processes.

The objectives of value engineering are to provide a better product for less cost. This includes the cost of ownership and the cost of acquisiton. Additionally, businesses can capture a bigger share of realized profit through value engineering incentives. The sharing of savings is identified in such a way that a contractor may achieve payment for value engineering done to a competitor's processes or technical data package.

X. BENEFITS TO CONTRACTORS FROM VECPs

Value engineering change proposals provide a source of income not available under other provisions of the contract. In 1984, one contractor

Figure 1. GOVERNMENT/CONTRACTOR SHARES OF NET ACQUISITION SAVINGS

(figures in percent)

Contract Type	Sharing Arrangement: Incentive (voluntary)		Sharing Arrangement: Program requirement (mandatory)	
	Instant contract rate	Concurrent and future rate	Instant contract rate	Concurrent and future contract rate
Fixed-price (other than incentive)	50/50	50/50	75/25	75/25
Incentive (fixed-price or cost)	-	50/50	*	75/25
Cost-reimbursement (other than incentive)**	75/25	75/25	85/15	85/15

*Same sharing arrangement as the contract's profit or fee adjustment formula.

**Includes cost-plus-award-fee contracts.

Note: Typical share ratios are shown, as determined by the contracting officer.

received payments equivalent to 3 percent of sales. This is income not limited to the legal limitations of profit. Additionally, a 1982 tax court (reference 4) ruled on a particular case that income from a VECP could be treated as long-term capital gains and, therefore, subject to lower taxation. The income represents a high return on capital employed and may be a return for reducing the cost of a competitor's product. Additional benefits are reimbursement of development cost on approved VECPs, which may provide usable technology on other product lines. This effort may provide a competitive edge on the item in production.

XI. VALUE ENGINEERING CHANGE PROPOSAL SUBMISSION REQUIREMENTS

The value engineering change proposal must contain complete and accurate cost data to include:

—Cost of the prior method or configuration
—Cost of the new method or configuration
—Cost of developing the VECP
—Cost of implementation of the VECP by both government and contractor to include test and evaluation
—Cost savings prediction on collateral expenses
—Cost savings on future contracts (unit cost reduction)
—Cost effect on government furnished equipment.

All previous submissions of the VECP must be identified, including the date and contract numbers involved and the disposition of the submission. Additionally, a list of contract requirements that must be changed for each VECP submitted must be presented and analyzed.

The proposal procedures follow the flow as shown in Figure 2.

The VECP is submittted to the contracting officer. He is to notify the contractor of the status within 45 days or provide a reason for the delay. The contracting officer may accept or reject any or all parts of the VECP, and his/her decision about sharing rates that will apply is final and not subject to the disputes clause.

An example of the use of VECP on a contract for a production item is at Figure 3. The contractor spends $2,000 to save $10,000 per unit. The government shares the net savings $8,000, 50/50 or $4,000 with the contractor.

Contractors are required to include value engineering clauses in any subcontract larger than $100,000 and may include them in lesser valued contracts. The subcontractors cost of development and implementation, and incentive payments paid by the prime contractor to the subcontractor, are allowable costs to the prime in calculating the cost of development and implementation to the government.

XII. GOVERNMENT CHALLENGES WITH IMPLEMENTATION

The following challenges have been identified by the DOD inspector general:

—Lack of promotion
—Lack of resources dedicated to the program
—Lack of up-front funding
—Slow processing of proposals
—Lack of program managers allocating funds for the program.

The successful implementation of a VECP program requires training of industry and the government participants. Recent surveys found that lack of sufficient and dedicated personnel to promote the program activity limits the awareness in government and industry. Work load considerations cause VECPs to receive a low priority from contracting officers and to fare poorly in the competition for resources. Other problems center around slow evaluation and processing of submitted proposals

Figure 2. VE PROPOSAL FLOW

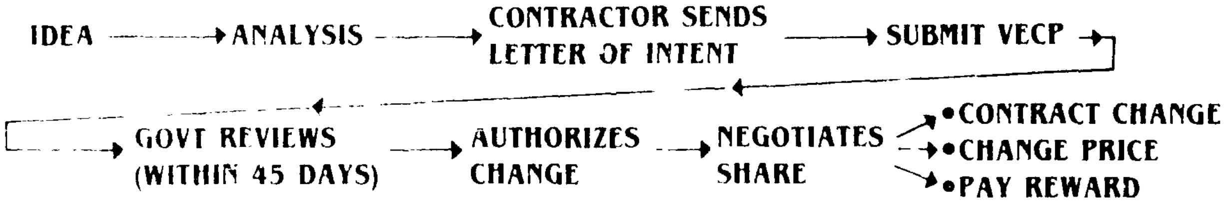


Figure 3. EXAMPLE OF SHARED SAVINGS

UNIT COST BEFORE Part # 55-01	$100,000	**SHARING OF SAVINGS** (assume Incentive Clause)
UNIT COST AFTER VECP Part # 55-02 (New)	90,000	—Instant Contract 50%
Unit Cost Reduction	$10,000	
Implementation and Development Cost	2,000	—Concurrent Contracts 50%
NET ACQUISITION SAVINGS	$8,000	—Future Contracts 50% (3 years)
NET INSTANT CONTRACT COST For Part # 55-02	$92,000	
		—Collateral
PAYMENT FOR SAVINGS (per unit)	$4,000	20% of 1 year savings typical over a 10-year period.

of over twice the 45-day target. Such untimely processing is a disincentive to contractors. Further, program managers are not able to reapply VECP savings until the contract modification has been negotiated and accepted.

XIII. IMPACT ON OTHER INCENTIVES

Only the benefits of an accepted VECP not rewarded under design to cost (production unit cost, or operations and support cost), reliability and maintainability, performance, or other similiar incentives will be rewarded under the VECP programs.

XIV. IN-HOUSE VE PROGRAM

An in-house VE program may be located in a headquarters, field activity, research laboratory, government-operated manufacturing facilities, or any government-owned and operated activity. It may be a formally chartered VE Task Team performing VE studies in high payback areas or areas identified by upper management, or it may consist of individuals using VE methods and techniques to reduce costs and improve productivity in their areas of responsibilities. They have in common their efforts resulting in VEPs submitted documenting the proposed improvements. These VEP identified improvements will have a net reduction in life-cycle costs to the DOD. Program managers, heads of activities and other management officials may exploit this in-house VE potential as part of their cost control/cost reduction efforts.

XV. SUMMARY

The savings that can be achieved through value engineering changes are sizeable for the government and can be extremely profitable for industry with potential of lower taxation (reference 4). The government has an obligation to inform and encourage the contractor to take advantage of the added profit opportunities through this incentive program. The contracting officer is the key to making the program work but present experience is that the program is inadequately funded by the government and inadequately resourced by government activities. The contracting officer should assure that procedures for review and processing of VECPs are established and that the contractor is aware of the procedures. He must then establish a review and evaluation process that adheres to the 45-day time limitation of response. To achieve the savings available, the contractor must perceive the opportunity to be real, with the provisions clearly spelled out and adhered to. For the government, timely processing improves the likelihood that the savings can be reapplied to approved but unfunded requirements.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 4.14
Version: Original
Date: December 1988

I. TITLE

Software Development Plan (SDP)

II. REFERENCES

—DOD Directive 5000.29, "Management of Computer Resources in Major Defense Systems," 26 April 1976

—Data Item Description, DI-MCCR-8003A, "Software Development Plan"

—DOD-STD-2167A, "Defense System Software Development," 29 February 1988

IV. PURPOSE AND SCOPE

This fact sheet describes:

—The Software Development Plan
—Its use in software development
—Its usefulness as a proposal evaluation tool.

IV. BACKGROUND

Digital systems are the heart and soul of all modern weapon systems. The flexibility offered by digital systems cannot be remotely approached by the now obsolete analog systems of the 1950s and early 1960s. Unfortunately, the tremendous growth of digital systems has introduced a whole new set of problems. These problems have included the introduction and proliferation of numerous programming languages, costly overruns, late deliveries, and systems that often fail to meet performance requirements upon initial delivery. To come to grips with the problems of software development, the U.S. Government has introduced software regulations and standards to force discipline and uniformity into the software development process. One of these standards is DOD-STD-2167A, "Defense System Software Development." This document describes a standard process and documentation for computer software development. One of the key pieces of documentation called out by DOD-STD-2167A is the Software Development Plan (SDP).

V. IMPORTANCE OF SDP

Managing software is very similar to managing hardware—both require discipline and control in order to succeed. An important part of this process is the formal determination of whether or not a candidate developer is capable of developing the system software. A key document in this determination is the SDP. Prior to contract award, the contractor is usually required to submit a preliminary SDP as an integral part of the proposal. This requirement is called out in the Instructions to Offerors portion of the Request for Proposal. Its submission as part of the proposal package helps government evaluators to determine the software development capability of the offeror. In general, the SDP describes the overall software system, software development management team and resources, software engineering practices and procedures, types and frequency of testing, the preliminary CSCI allocation and approach, the use of metrics and configuration management practices. In short, the SDP is the contractor's roadmap and list of supplies required to develop the system software.

After contract award, the SDP becomes the key software management document. The preliminary SDP is finalized prior to the Software Specification Review (SSR) as called out in DOD-STD-2167A. It

then becomes the guiding document for software development.

VI. CONTENTS OF SDP

The contents and format of the SDP is defined and controlled by a Data Item Description (DID) called out in the Contract Data Requirements List (CDRL). The DID for the SDP is DI-MCCR-80030A, "Software Development Plan." This DID requires the following information:

- Table of Contents
- Scope
- Referenced Documents
- Software Development Management
  - —Project development and resources
    - —Contractor facilities
    - —Government furnished equipment, software, and services
    - —Organization structure
    - —Personnel
  - —Schedules and milestones
    - —Activities
    - —Activity network
    - —Source identification
  - —Risk management
  - —Security
  - —Interface with associate contractors
  - —Interface with software Independent Verification and Validation (IV&V) agents
  - —Subcontractor management
  - —Formal reviews
  - —Software development library
  - —Corrective action process
  - —Problem/change reports
- Software Engineering
  - —Organization resources
    - —Organization structure
    - —Personnel
    - —Software engineering environment
      - —Software items
      - —Hardware and firmware items
      - —Proprietary nature and government rights
      - —Installation
  - —Software standards and procedures
    - —Software development techniques and methodologies
    - —Software development files
    - —Design standards
    - —Coding standards
  - —Non-developmental software
- Formal Qualification Testing
  - —Organization and resources
  - —Test approach/philosophy
  - —Test planning assumptions and constraints
- Software Product Evaluation
  - —Organization and resources
  - —Software product evaluations procedures and tools
  - —Subcontractor products
  - —Software product evaluation records
  - —Activity-dependent product evaluations
- Software Configuration Management
  - —Organization and resources
  - —Configuration identification
    - —Developmental configuration identification
    - —Identification methods
  - —Configuration control
    - —Flow of configuration control
    - —Reporting documentation
    - —Storage, handling and delivery of project media
  - —Configuration status accounting
  - —Configuration audits
  - —Preparation for specification authentication
  - —Configuration management major milestones
- Other Software Development Functions
  - —Metrics
- Appendices

VII. SUMMARY

The Software Development Plan is a key document in the software development process. It serves the dual purpose of allowing the government source selection team to evaluate the contractor's ability to develop software and providing the developer's software manager a tool for controlling the software development process.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department

Number 4.15
Version: Original
Date: January 1989

I. TITLE

Software Quality Assurance

II. REFERENCES

—DOD Directive 5000.29, "Management of Computer Resources in Major Defense Systems," 26 April 1976

—DOD-STD-2168, "Defense System Software Quality Program," 29 April 1988

—Evans, Michael W., and John J. Marciniak, "Software Quality Assurance & Management," John Wiley and Sons, New York, N.Y., 1987

III. PURPOSE AND SCOPE

This fact sheet:

—Defines software quality
—Describes the process for the development of quality software
—Discusses the limits and constraints involved in the management of a quality software development program.

IV. BACKGROUND

Digital systems are the heart and soul of all modern weapon systems. The flexibility offered by digital systems cannot be remotely approached by the now obsolete analog systems of the 1950s and early 1960s. Unfortunately, the tremendous growth of digital systems has introduced a whole new set of problems. These problems have included the introduction and proliferation of numerous programming languages, costly overruns, late deliveries, and systems that often fail to meet performance requirements upon initial delivery. To come to grips with the problems of software development, the U.S. Government has introduced software regulations and standards in an attempt to force discipline and uniformity into the software development process. One of these standards is DOD-STD-2168, "Defense System Software Quality Program." This document describes the requirements for the development, documentation, and implementation of a software quality program. The DOD-STD-2168 is a companion document to DOD-STD-2167A, "Defense System Software Development." These two documents form the basis for quality DOD software development.

V. SOFTWARE QUALITY

Software is not mass produced so that the development and manufacture of software are synonymous. Once software development is completed, the production of identical copies is a trivial process.

The measurement of software quality is not yet a science. Should software quality be measured in terms of the numbers of errors found and fixed during some period of time relative to the size of the software? Or, should software quality be defined by the ability of the software to perform a task over a period of time with a quantifiable degree of reliable performance? Because of the current state-of-the-art, it is not presently possible to define software quality in terms of formal absolutes.

A widely-accepted definition of software quality, however, defines it as: (1) the measure of acceptability of software products in relation to the application, environment, and role of the product in the context of the project, (2) the totality of

features and characteristics of a software product that bear on its ability to satisfy given needs; for example, to conform to specification, (3) the degree to which software possesses a desired combination of attributes, and (4) the degree to which customers or users perceive that the software meets their expectations [Evans et al].

VI. PROCESS CONTROL

Process control is the key to achieving software quality. The process is the method used by the contractor for developing software. Achieving control of the process means that the process is predictable and measurable. A controlled process will minimize variability. How does a program manager (PM) assess the contractor's process control system and procedures? Table 1 provides a series of questions developed by the Software Engineering Institute as an aid in making this assessment. The PM must know that the process represents the contractor's commitment, philosophy, methodology, procedures, and standards for doing business. Process control and process management are principles of the Deming philosophy for customer satisfaction. Application of Deming's philosophy requires the commitment of top management. That is why it is so important to select the right contractor; these values are not learned overnight.

The following are some program management guidelines which focus on the day-to-day management of software development:

—*All Software Tasks Must Be Discrete.* This guideline is fundamental in determining how well the contractor can plan the effort. Program managers must not allow level of effort or percent complete approaches because this closes the door on program progress visibility. The contractor must be able to define the work packages associated with the work breakdown structure (WBS) in sufficient detail to control and manage the effort. Each task should have a definite start, a definite end date, and a specific output. These tasks are normally on the order of 30-90 man-days in duration. Planning is usually accomplished as a rolling wave, the immediate 6 months or more are planned in detail with the remaining effort generally only visible at higher levels in the WBS. The *entire* effort must be totally scoped in time and resources at the very beginning of the project.

—*Quantitative Requirements are Managed Through Margins.* Quantitative requirements lend themselves to measurable control methods. For example, computer memory and throughput are often tracked during development. In the beginning, estimates of software size and timing will be made and compared against target values to determine margins. Later, design language estimates can be made and these estimates will continue through the design process. As code is written, actual measurements can be made. Early planning should allow for contractor and government margins with the use of a disciplined and documented control system. One approach is to baseline an estimate of the memory and throughput utilization on a monthly basis. An alert or trigger threshold value can initiate action should the threshold values be exceeded.

—*Identify and Track Risk Areas.* The contractor and PM should be working as a team to manage program risk. An important ingredient of any program is to assess and reduce the risk as early as possible and before Milestone II. Risk management is an ongoing process. The first step is to identify risk areas, document them in the Software Development Plan, and devise a scheme for dealing with each risk item. These items are then tracked throughout development. A convenient method is to have a "Top Ten" list of risk areas that are tracked at least on a monthly basis along with a contingency plan for mitigating the identified risks. The plan should establish risk reduction objectives and schedules, assign responsibility and priority for risk reduction tasks, and develop a method for periodic reviews and assessments. Various management techniques to reduce risk include:

- —Rapid prototyping
- —Incremental development
- —Internal (government) program reviews (at least monthly)
- —Top Ten list review
- —Early demonstrations and testing of risk items
- —Government inspections and audits of the software development process.

Some potential problem areas include:

- —Unrealistic cost and schedule
- —Vague or incomplete requirements
- —Inexperienced developers
- —Inadequate development environment (tools and .. ethodology).

Table 1. PROCESS CONTROL

- **Is a mechanism used for ensuring traceability between the software top-level and detailed designs?**
- **Are internal software design reviews conducted?**
- **Is a mechanism used for controlling changes to the software design?**
- **Is a mechanism used for ensuring traceability between the software detailed design and the code?**
- **Are formal records maintained of unit (module) development progress?**
- **Are software code reviews conducted?**
- **Is a mechanism used for controlling changes to the code? (Who can make changes and under what circumstances?)**
- **Is a mechanism used for configuration management of the software tools used in the development process?**
- **Is a mechanism used for verifying that the samples examined by software quality assurance are truly representative of the work performed?**
- **Is there a mechanism for assuring that regression testing is routinely performed?**
- **Is there a mechanism for assuring the adequacy of regression testing?**
- **Are formal test case reviews conducted?**

—*Identify and Track Special Interest Items.* Special interest items such as government furnished items (hardware, software and data) and subcontract items should also be tracked. Any items delivered to the contractor or received from the contractor are candidates for tracking. Certain critical internal deliveries such as code delivered for testing are candidates as well. The same approach used for tracking the risk items above can also be used to track special interest items.

—*Requirements Must Be Testable and Traceable.* Requirements must be testable in order to validate the system performance. In some cases, actual testing may be impractical due to physical constraints, cost, or other considerations. When this is the case, system performance must be validated through inference or analysis and reflected in a testability matrix. Traceability is a key factor throughout development and becomes even more important during follow-on support. Requirements must be traceable from the system specification down through design, integration testing and DT&E. Traceability must occur in both directions—results of a test report must track back to the requirements. The only effective way to handle this for large programs is through some form of automation. Requirements traceability should be an integral part of the contractor's configuration management process.

—*Use Checklists for Design Reviews.* Without adequate preparation, design reviews can become nothing more than hectic "dog and pony shows." Design reviews should be a major part of the software quality program. Program office personnel should be prepared for a review by arming themselves with appropriate analyses and a checklist of important and critical questions and adhering, as much as possible, to an agreed-to formal agenda. The PM must do homework through verification and analyses of critical areas that support the design approach. The MIL-STD-1521B, "Technical Reviews and Audits for Systems, Equipments, and Computer Software," provides guidance on preparing checklists for various reviews. The checklists should also include special interest items and risk areas.

—*Formal Reviews Must Be Viewed As Quality Gates.* Program managers must approach the formal review as a checkpoint for determining whether or not the project is ready to proceed to the next phase. A contractor should not be allowed to complete a design review if it hasn't satisfied all the requirements imposed by the design review. If the PM decides to proceed to the next phase with a less-than-satisfactory technical review, because of political or schedule considerations, the risks involved must be known and a contingency plan developed. Too often, however, the risks are much

higher than perceived. It is essential to have a stable baseline since early mistakes become much harder and costlier (in time and money) to correct when they are discovered late in the development process. Proceeding before one is ready usually increases the program risk.

—*Conduct Periodic Inspections and Audits*. Periodic government inspections and audits can be useful when applied consistently. Inspections generally use a checklist to determine the specification and design completeness. Audits are similar to inspections with the additional factor of determining requirements traceability. These techniques can be valuable when applied to the interfaces. What better way to integrate the system than to ensure that the hardware and software properly communicate with each other? In addition to inspections, the contractor should also conduct walk-throughs as a standard business practice.

—*Use Statistics/Metrics Generated By Contractor Internal Reviews*. The contractor must have a system in place that includes a means of assessing the quality and progress of the work. The Software Development Plan should identify the software development system and indicate how government visibility will be provided. This is generally accomplished by contractually requiring the developer to provide the assessment data to the program office. The purpose is not for the government to manage the contractor's work (that's the contractor's job), but to communicate program development status and product quality. The contractor should gather statistics from the internal walk-throughs and inspections and use this data to manage the software development. The mechanisms the contractor has in place for software development constitutes the process control system. The contractor's software process control system is analogous to a manufacturing process control. Statistics at this level will provide valuable trends and indicators to program management.

—*Integration Must Be Visible On Master Schedule*. Integration brings the interfaces together. They occur at all levels—software to software, software to hardware and software to systems. Integration and integration testing must be planned and be highly visible to the government PM. It is important to approach the development of hardware and software as a maturing process strategy. Pieces of the system should be brought together in a planned, logical fashion. Some level of confidence in the hardware and software components must be established before proceeding with higher level integration. If this isn't done, problems that occur during integration will be difficult to diagnose since they may be in either component—hardware or software. Integration of the system, particularly the critical components, are likely candidates for special interest or risk item tracking.

VII. SUMMARY

Software quality must be planned into the program, engineered into the products of development, and be monitored by assessing not only individual segments of the program or single data products but also by evaluating the interactions and interrelationships between them. Quality goals must be clearly defined, effectively monitored, and rigorously enforced. The program must focus on the quality issues of the program from the outset, ensuring that quality criteria are consistent with defined requirements. Throughout software development, the management of software quality must be an overriding concern of all program personnel. Quality must be planned into the program structure, constantly evaluated, and corrections applied when deficiencies are identified.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department

Number 4.16
Version: Original
Date: December 1988

I. TITLE

Software Engineering—Development Cycle

II. REFERENCES

—DOD-STD-2167A, "Defense System Software Development," 29 February 1988

—DODD 5000.29, "Management of Computer Resources in Major Defense Systems," 26 April 1976

—*Mission Critical Computer Resources Management Guide*, Defense Systems Management College, September 1988

III. PURPOSE AND SCOPE

This fact sheet is designed to:

—Provide an insight into the management aspects of software development

—Provide a description of the software development process

—Identify major activities that make up the process.

IV. DEPARTMENT OF DEFENSE (DOD) POLICY

Fact Sheet 4.7 describes policy regarding mission critical computer resources.

V. SOFTWARE DEVELOPMENT CYCLE

Development of software is a rigorous process of integrating technical, administrative, and management disciplines into a cohesive, well-planned and controlled structure. Software development should be treated as an engineering discipline, not as a technical art form. The software development process will follow closely to that of a hardware development process and differences between the two will be discussed. As with hardware, our goal is to develop a quality product (in this case, software) consistently within schedule and cost. The value of software cost and schedule estimations is totally determined by the amount of planning and level of commitment that is applied toward its development from the onset. The planning process cannot be ignored

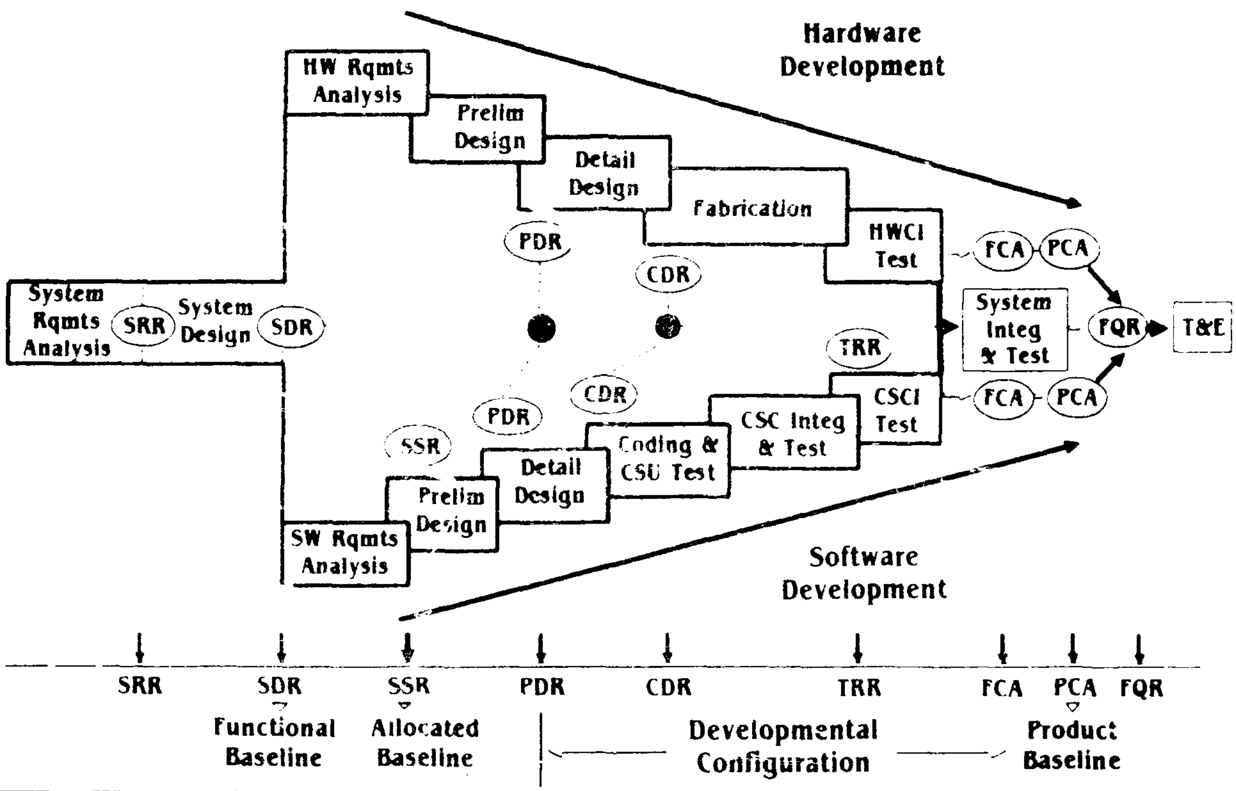
There are six steps in the software development cycle as defined in DOD-STD-2167A (see Figure 1): software requirements analysis, preliminary design, detailed design, coding and computer software unit (CSU) test, computer software component (CSC) integration and test, and computer software configuration item (CSCI) test. The DOD-STD-2167A is an attempt to standardize the development process for software and to reduce the documentation through streamlining efforts. It established the requirements to be applied during the development and acquisition of mission critical computer resources (MCCR) software, as defined in DODD 5000.29. It may also apply to non-MCCR software. The software development cycle may occur one or more times during each of the system life cycle phases and should be modified accordingly.

Basically, software requires the same reviews/audits as hardware; these reviews/audits should occur prior to the overall system reviews/audits (Reference MIL-STD-1521B). There are two additional reviews required for software:

—Software specification review (SSR): The purpose is for the developer to demonstrate the adequacy of the operational concept document and software development specifications.

Figure 1. LIFE CYCLE PHASE ACTIVITIES

SOFTWARE/HARDWARE DEVELOPMENT



—Test readiness review (TRR): The purpose is to determine if the software test procedures are complete and that the developer is prepared for formal CSCI testing.

Software Requirements Analysis

The purpose is to define functional, performance, interface, and qualification requirements for each CSCI, based on the system specification.

—Activities

1. The developer will prepare/update the software development specification (Type B-5); software requirements specifications (SRS) and interface requirements specifications (IRS).

2. The developer may perform the following activities:

—Identify detailed functional requirements
—Identify detailed performance requirements
—Identify hardware/software interface requirements
—Identify qualification requirements
—Identify support tools and resources
—Establish timing/sizing estimates
—Conduct internal requirements reviews.

3. The developer should conduct software specification reviews (SSR) on CSCIs, as necessary when system level software requirements are defined/allocated to establish the formal allocated baseline for CSCIs and to demonstrate the adequacy of software development specifications as a basis for proceeding into preliminary design.

Preliminary Design

The purpose is to produce a top-level design which reflects the specified and agreed-upon software design requirements.

—Activities

1. The software developer will produce the software top-level design and develop the associated preliminary software design documents (SDD) and

interface design documents (IDD). He/she will layout the test planning program and produce the overall software test plan (STP).

2. The developer may perform the following activities:

- —Update cost/timing estimates
- —Determine "make or buy" of software
- —Acquire support tools and resources
- —Build software prototypes
- —Install software support tools
- —Start design of lower level critical components
- —Conduct internal test/design reviews.

3. The developer should conduct preliminary design reviews (PDR) on CSCIs, as necessary, when the top-level design requirements for the CSCIs have been met.

Software Detailed Design

The purpose of this step is to refine the top-level design into a complete modular lower-level software design.

—Activities

1. The developer will produce the software detailed structural design and finalize the SDD and STP. He/she will develop the detailed data base design, refine top-level CSCs into lower-level CSCs and CSUs, define formal CSCI and unit tests, develop software test cases, and establish the software development library to maintain all applicable software documentation.

2. The developer may perform the following:

- —Update previous cost/schedule estimates
- —Maintain files and internal records
- —Begin development of operational and support documentation
- —Conduct internal technical reviews.

3. The developer will conduct critical design reviews (CDR) for each CSCI once all design criteria have been met. He/she will ensure that developmental configuration control is implemented once the CDRs are completed/accepted.

Coding and Computer Software Unit (CSU) Testing

The purpose is to develop source/object code and to test each CSU making up the detailed design as defined in the detailed design activity of the development cycle.

—Activities

1. The developer will produce the object/source code for CSUs and test those CSUs in accordance with the methodology outlined in the software development plan and release the results to the software development library. He/she will prepare the software test procedures (STPR) to define software integration test procedures, preliminary CSCI formal test procedures, and detailed CSC test procedures.

2. The developer may perform the following:

- —Update operational/support documents
- —Conduct internal reviews
- —Analyze test results
- —Revise design documentation and code, as necessary
- —Maintain software master library and software development folders (SDF)
- —Maintain developmental configuration control following successful CSU testing.

CSC Integration and Testing

The purpose is to produce an integrated software product and ensure that the software is ready for formal testing at the CSCI level.

Activities:

1. The developer will integrate and test aggregates of CSCs in accordance with the software development plan, produce source/object code for each CSCI and complete the detailed software test procedures (STPR).

2. The developer may perform the following:

- —Update operational/support documents
- —Make necessary revisions to design documents
- —Monitor memory, processing time and resource utilization
- —Conduct informal software reviews.

3. The developer will conduct test readiness reviews (TRR) to ensure that the CSCIs are ready for formal testing in accordance with the STPRs.

CSCI Testing

The purpose of the CSCI testing is to perform formal tests on each CSCI and determine the software product baseline.

—Activities

1. The developer will perform formal tests on each CSCI in accordance with test procedures, record

the results of the testing and prepare the software test reports (STR). He/she will complete the operator and support documents (Computer System Operator's Manual, Software User's Manual, Software Programmer's Manual, Firmware Support Manual, and Computer Resources Integrated Support Document), develop the appropriate version description documents which identify the versions of CSCIs completed, and produce the software product specification (Type C-5). At this time, the developer will release the developed code to the system integrator.

2. The developer may perform the following:

- —Update/complete all documentation
- —Make necessary revisions to prepare the software product for delivery
- —Conduct informal reviews
- —Update the software development folders and software library
- —Perform retesting, as necessary.

3. The developer will conduct functional and physical configuration audits (FCA/PCA) on each CSCI prior to their release for system integration and testing.

VI. SUMMARY

The DOD-STD-2167A has done a lot to standardize the development of software. It establishes an accepted methodology/process consisting of six steps for developing software and reduces to only 18 the many, many documents used previously. The DOD-STD-2167A even allows tailoring these documents to suit an individual program to further reduce the documentation dilemma. In conjunction with DOD-STD-2168, "Defense System Software Quality Program," the management of software development can now be more easily understood.

Figure 1 summarizes the software development cycle, showing the various baselines as building blocks during the software development process. It reflects the activities (audits/reviews), phases, and baselines associated with the development of software and its relationship with hardware development. Table 1 depicts the 18 documents, along with their respective data item descriptions, normally required.

Table 1. DATA ITEM DESCRIPTIONS (DOD-STD-2167A and DOD-STD-2168)

TITLE	NUMBER
SYSTEM/SEGMENT SPECIFICATION (SSS)	DI-CMAN80008A
SYSTEM/SEGMENT DESIGN DOCUMENT (SSDD)	DI-CMAN-80534A
SOFTWARE DESIGN DOCUMENT (SDD)	DI-MCCR-80012A
VERSION DESCRIPTION DOCUMENT (VDD)	DI-MCCR-80013A
SOFTWARE TEST PLAN (STP)	DI-MCCR-80014A
SOFTWARE TEST DESCRIPTION (STD)	DI-MCCR-80015A
SOFTWARE TEST REPORT (STR)	DI-MCCR-80017A
COMPUTER SYSTEM OPERATOR'S MANUAL (CSOM)	DI-MCCR-80018A
SOFTWARE USER'S MANUAL (SUM)	DI-MCCR-80019A
SOFTWARE PROGRAMMER'S MANUAL (SPM)	DI-MCCR-80021A
FIRMWARE SUPPORT MANUAL (FSM)	DI-MCCR-80022A
COMPUTER RESOURCES INTEGRATED SUPPORT DOCUMENT (CRISD)	DI-MCCR-80024A
SOFTWARE REQUIREMENTS SPECIFICATION (SRS)	DI-MCCR-80025A
INTERFACE REQUIREMENTS SPECIFICATION (IRS)	DI-MCCR-80026A
INTERFACE DESIGN DOCUMENT (IDD)	DI-MCCR-80027A
SOFTWARE PRODUCT SPECIFICATION (SPS)	DI-MCCR-80029A
SOFTWARE DEVELOPMENT PLAN (SDP)	DI-MCCR-80030A
SOFTWARE QUALITY PROGRAM PLAN (SQPP)	DI-QCIC-80572

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 4.17
Version: Update
Date: March 1989

I. TITLE

Producibility

II. REFERENCES

—MIL-HDBK-727, *Design Guidance For Producibility*, 5 April 1984.

—AFWAL-TR-83-4033, Volumes I-VII, *ICAM Manufacturing Cost/Design Guide*, AFWAL/MLTC, WPAFB, Ohio 45433, September 1984.

—GAO/NSIAD-85-34,"Why Some Weapon Systems Encounter Production Problems While Others Do Not: Six Case Studies," May 24, 1985.

—DOD 4245.7-M, *Transition From Development To Production*, April 1985.

—NAVSO P-6071, *Best Practices*, Department of the Navy, November 1985.

—*DOD Manufacturing Management Handbook*, Second Edition, Defense Systems Management College, July 1984.

—DOD Directive 5000.34, "Defense Production Management," October 31, 1977.

III. Points of Contact

U.S. Army
Deputy Chief of Staff For Production
HQ Army Materiel Command
5001 Eisenhower Avenue
Alexandria, Virginia 22333-0001
(301)274-8298

U.S. Navy
The Office of the Assistant Secretary of the Navy
(Ship Building and Logistics)
RM&QA
Washington, D.C. 20360-5000
(202)692-1749

U.S. Air Force
Director of Product Assurance Engineering
HQ Air Force Systems Command
Andrews Air Force Base
Washington, D.C. 20334-5000
(301) 981-6429

Department of Defense
Director
DOD Product Engineering Services Office
5203 Leesburg Pike, Suite 1400
Falls Church, Virginia 22304
(703)756-2335

IV. GENERAL

—Producibility. The relative ease of producing an item or system which is governed by the characteristics and features of a design that enable economical fabrication, assembly, inspection and testing using available prodiction technology. (DODD 5000.34)

Producibility is an engineering function directed toward achieving a design which is compatible with the realities of the available manufacturing procesess. This compatibility has large potential impacts upon product quality, unit production cost, the ability to increase rapidly production rates and life-cycle operation and support costs. High unit production costs, high maintenance costs and poor field reliability often have their causes in insufficient attention having been given to producibility

engineering and its planning. Products which are inherently difficult to fabricate, assemble and test in the controlled environment of the production facility are potentially impossible to regularly operate and maintain in the field.

Unfortunately, engineering design activities that are necessary for product development are often treated as a discrete functional activity, with little or no involvement of the other plant functions; e.g., manufacturing, quality assurance or production engineering. Particular projects are often compartmentalized within a multiprogram organization. This approach to product development stresses performance and gives little attention to procducibility considerations. As a result, the product's design meets performance specifications at the completion of development, but does not allow for the limitations of manufacturing processes and procedures found on the factory floor. Hence, the apparently mature product configuration does not survive rate production without performance degradation, and significant redesign is required for efficient production.

—Contractor's Role. Producibility is an integral part of the systems engineering process. Therefore, the producibility effort must be performed by a team of specialists from across the program and supporting functions. One individual cannot possibly accomplish the total producibility effort without assistance from other functional areas. Considering the number of new processes and materials that are being developed, materials specialists should be brought into the areas of manufacturing, test and evaluation and the design process. People from the various disciplines are necessary so that a detailed interaction can occur between the product designers and the production personnel who have specific knowledge of the available manufacturing technologies and their relevant costs.

Producibility is often identified as one of the items to be covered in a design review but is not discussed as one of the major cost drivers in the transition from development to production. Several DOD directives and MIL-STDs discuss the topic of production design but provide very little direction or guidance. Producibility, as a subset of production design, is usually not a major concern during the design review activity. As a result, it is not given sufficient attention to impact the design process in the early development phases.

The first step in the design process is to review the functional requirements. After the design has been scrubbed for unnecessary requirements and reviewed for completeness and clarity, ideas are formulated on how to meet the cited requirements. Here producibility is considered as part of the design criteria to be evaluated for cost-effectiveness and ease of manufacture versus the degree of compliance with the functional requirements. Preliminary analyses should be made tentatively to select components, configuration, materials and processes without locking onto the design of any specific selections. These initial selections merely provide a basis for the designer to evaluate the concept. With a number of possibilities to consider, analysis is required to choose the approach that shows the greatest promise. As a minimum, analyses should be made of the risks involved in design alternatives; function versus cost, schedule versus cost and component design versus manufacturing capability.

The achievement of production phase objectives usually requires the use of the most efficient, shop-proven, processes for material transformation. These two process descriptors, efficient and shop-proved, often tend to be mutually exclusive. New processes and approaches to manufacturing, such as computer-aided manufacturing, often do not have extensive shop experience. The challenge is to maintain maximum efficiency of manufacture within the risk levels deemed acceptable for the specific program. It is important to recognize that advanced manufacturing technology generally brings certain levels of risk to a program along with the potential benefits of improved efficiency. However, advanced manufacturing technologies often can be avoided by the use of standardization, statistical process control, tolerance analysis and designing for assembly.

A contractor design policy should be established which specifically outlines the considerations to be implemented during the production design process. Management participation in design and producibility reviews is critical to its success. Colocation of design engineers, production engineers and the producibility function greatly encourages cooperation, communication and participation in

early reviews of the design to assure its eventual producibility at rate. Producibility must be confirmed before the production decision to assure that a stable mature design is transitioned to the factory. In addition, it is manadatory for low risk that proof-of-manufacturing models be required and that all processes be proofed to assure that the design is indeed consistent with production processes and capabilities. Very often proof-of-manufacturing models are not provided or required which results in tooling and process problems not being totally resolved before production. As a consequence, many producibility-type issues are not discovered until production, and depending upon the severity of these problems, rate production may be impacted severely. Retooling, new equipment, considerable redesign, exotic manufacturing processes and the like are often required—at great additional expense and time—to achieve required production quantities.

Once production begins, statistical process control should be implemented as soon as practical for all manufacturing processes. Statistical process control is necessary to control variability in manufacturing and ensure original design specifications are not degraded during production. Control of manufacturing processes and the resulting consistency of design is impossible without statistical process control.

—Government's Role. The government's acquisition strategy and contracting approach have major impacts on a system's producibility. The government's approach and emphasis will determine how well the contractor incorporates producibility into the end-product. Proposed production rates and quantities affect the contractor's cost structure, business plans, facilities and selected manufacturing methods and processes. Stable rates and quantity are a prerequisite for product quality and declining unit production cost. The government's funding and tracking of producibility engineering and planning (PEP) activities can force discipline and visibility for the early consideration of producibility. The use of several, incrementally phased production readiness reviews (PRR) should be used to manage the PEP effort and to identify production risks. In order to manage the PRR and PEP efforts, the PMO must staff itself with individuals appropriately trained in manufacturing and industrial engineering. The contractor must also be encouraged to utilize statistical process control rather than to rely solely on product inspection.

V. SUMMARY

Producibility is an integral part of the systems engineering process and must be considered beginning in concept exploration. Producibility has both economic and engineering aspects and requires planning and cooperation between the government and contractor. Failure to consider producibility may require costly and time-consuming modifications to the design and the manufacturing process in order that performance and quality requirements can be met.

INSERT TAB 5

LOGISTICS MANAGEMENT

FACT SHEET PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number 5.1
Version: Update
Date: December 1988

I. TITLE

Integrated Logistics Support Plan (ILSP)

II. REFERENCES

—DODD 5000.1, "Major and Non-Major Defense Acquisition Programs"

—DODI 5000.2, "Defense Acquisition Program Procedures"

—DODD 5000.39, "Acquisition and Management of Integrated Logistics Support for Systems and Equipment"

—HQO P4105.1, "USMC ILS Planning Manual"

—SECNAVINST 5000.39, "USN Acquisition and Management of ILS for Systems and Equipment"

—OPNAVINST 5000.49A, "ILS in the Acquisition Process"

—AR 700-127, "USA Integrated Logistics Support"

—AF Regulation 800-8, "Integrated Logistics Support (ILS) Program"

III. POINTS OF CONTACT

Chief of Naval Operations (OP-462)
Washington, D.C. 20350
(202) 692-7886; AV 222-7886

Headquarters, U.S. Army Materiel Command (AMC SM-SID)
5001 Eisenhower Avenue
Alexandria, Virginia 22333
(202) 274-5464; AV 284-5464

Headquarters, U.S. Air Force (LEYY)
Washington, D.C. 20330
(202) 697-9178; AV 227-9178

Marine Corps Research, Development and Acquisition Command (PSL)
Washington, D.C. 20380
(202) 694-1630; AV 224-1630

IV. PURPOSE AND SCOPE

This fact sheet is designed to:

—Describe the purpose, use and generalized format of the Integrated Logistics Support Plan (ILSP).

—Be general in scope (i.e., service-unique practices and procedures are not stressed herein).

V. POLICY

It is the policy of the Department of Defense that the program manager shall develop a draft ILSP by Milestone I, complete it by Milestone II, and keep it current throughout the acquisition process. The ILSP shall integrate the logistics aspects of the program. Positive controls shall be established to integrate schedules and to identify interdependencies among ILS elements, design activities and deployment plans. The ILSP shall document readiness and support objectives and demonstrated achievements, Logistics Support Analysis (LSA) Strategy, operating concepts and deployment requirements (including transportability), support concepts and plans, ILS element requirements, schedule, funding requirements and responsibility for ILS activity planned for each program phase.

VI. BACKGROUND

The ILSP is a management tool that delineates anticipated future logistical planning actions by the program office and external supporting activities. It should be considered the foundation document for coordinating logistic planning efforts to ensure that each of the ILS elements is addressed and in-

tegrated with the other elements throughout the program's life cycle. It contains the details which form the basis for specific actions by supporting activities and for developing logistic requirements to be included in contractual documents. The ILSP provides the foundation for coordinated action on the part of the Logistic Element Managers and the contractor, and documents the manner in which each of the applicable elements of logistic support is to be obtained, integrated with the other elements, and sustained throughout the life cycle.

An ILSP will be developed covering all government and supporting contractor actions for each weapon system or equipment acquisition. The program manager shall ensure that all required staff agencies participate in the planning process and in development of the ILSP.

The ILSP will be based on the constraints, operational concept and use scenario contained in the basic program planning documents. The plan will be tailored to the specific needs of each program and will address the total materiel system including each of the elements of logistics. When approved, the ILSP becomes the implementation plan for all participating activities and is treated as an integral part of the program plan. Effective implementation of the ILSP is a major management challenge due to the complexity of materiel systems and the multitude of interfaces.

VII. TIME PHASING OF ILSP

The ILSP is essential during every phase of the acquisition process. It initiated at the outset of the program, in the concept exploration/definition (CE/D) phase, and is maintained through the full-rate production/deployment (FRP/D) phase. The function of an ILSP is to identify what logistics support tasks will be accomplished, how and when they will be accomplished, and who will be responsible for their accomplishment.

Concept Exploration/Definition Phase: A broad tentative ILSP based on the information contained in the basic planning documents (i.e., baseline operational scenario, and preliminary support concepts). By Milestone I, the ILSP should include specific tasks to be accomplished during the concept demonstration/validation (CD/V) phase, identify the responsible service agencies and activities, and the schedule for task completion. Those logistics tasks and logistics technical requirements that are required to be accomplished by the contractor will be communicated to the contractor through the CD/V demonstration/validation contract package. The ILSP should also project requirements, tasks and milestones for future acquisition phases.

Concept Demonstration/Validation Phase: The government program manager has responsibility for review and update of the ILSP but depends heavily on the contractor to provide input for the updates as data become progressively more detailed as the program design moves from the conceptual through the preliminary to the detailed stages. Prior to entering the Full-Scale Development (FSD) Phase, the update of the ILSP will be completed by the government ILS manager and reflect the results of the concept demonstrations and validations. Those logistics tasks and logistics technical requirements that are required to be accomplished by the contractor will be communicated through the FSD contract package.

Full-Scale Development Phase: The ILSP is a working document with continuous government and contractor involvement in reviewing, refining, expanding and updating the plan. The ILSP will be updated:

—When new program direction is received.

—When there are changes that involve personnel, training, facilities and other ILS elements.

—When there are major system configuration changes.

During the FSD phase the ILSP will address the responsibilities of the government and the contractor in support of systems test and evaluation. Prior to entering the production phases, the update of the ILSP will be completed by the government ILS manager and reflect the results of the FSD phase. Again those tasks and logistics technical requirements that are required to be accomplished by the contractor will be communicated through the production contract package.

Full-Rate Production/Deployment Phase: The results of this phase is a measure of how well the government defined its logistics requirements in the ILSP, and implemented the plan. Based upon data gathered from the previous phases, types and quantities of support equipment, technology, spares and repair parts are acquired from the contractor; personnel are trained, facilities built, data

released by the contractor on how to package, handle store and transport support resources.

As the required support is delivered to the field, that part of the ILSP addressing follow-on fielding support assessment is implemented to determine if any changes are needed.

VIII. CONTENT AND FORMAT

The content and format of the ILSP may vary according to service and shall be subject to tailoring based on the nature and needs of the specific program. Each of the following items must be considered and discussed as applicable:

a. *System Description* including government furnished equipment (GFE), government furnished material (GFM) and associated support items of equipment.

b. *Organizational* responsibilities and relationships of agencies and organizations supporting the ILS manager.

c. *Operational and Organizational Concept* involving mission requirements, operational environment and other required LSA input parameters.

d. *System Readiness Objectives* (SRO) for both peacetime and wartime situations.

e. *Logistics Acquisition Strategy* involving contractual approaches and incentives for LCC, R&M and supportability goals.

f. *LSA Plan* which, due to its importance in realizing program and ILSP objectives, may be included as a separate document. This plan describes the approach to LSA and the results expected.

g. *Supportability Test and Evaluation Concepts* involving identification of specific test issues related to overall ILS objectives and to each ILS element.

h. *ILS Elements* will be addressed as to ILS objectives, concepts, trade-off factors, goals, thresholds, special requirements, responsibilities, and validation and verification requirements. The manner in which each applicable element of ILS is obtained and integrated with the other elements will be documented.

i. *Support Transition Planning* describing the plans for transition from contractor to government support. The planning will involve each of the applicable ILS elements.

j. *Support Resource Funds* involving ILS-related life-cycle funding requrements (funded and unfunded) will be identified by ILS element, program function and appropriation category.

k. *Post Fielding Assessments* involving plans for analyzing and assessing field data feedback related to materiel support and support system performance. The plans will address assessment methodology, identify milestones and responsibilities and describe the strategies for improvements.

l. *Milestone Schedule Charts* showing the interrelationships of specific logistic support related tasks and events to the overall program milestones and to each other.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 5.2
Version: Update
Date: December 1986

I. TITLE

The Training Plan

II. REFERENCES

—DOD, MIL-STD-1379B, 'Contract Training Program"

—ACQ-7, DOD, "Training Simulator and Device Guidelines"

—USA, AR 70-8, "Personnel Performance and Training Program"

—USA, AR 71-2, "Force Development Basis of Issue Plans—Qualitative and Quantitative Personnel Requirements Information"

—USA, AR 350-1, "Army Training"

—USA, AR 350-35, "Army Modernization Training"

—USA, AR 350-38, "Training Device Policies and Management"

—USA, AR 351-1, "Individual Military Education and Training"

—USN, OPNAVINST 1500.8L, "Navy Training Planning Process in Support of New Developments"

—USN, OPNVINST 1551.7B, "Fleet Participation in Development, Acquisition and Acceptance of Major Training Devices"

—USN, OPNAVINST 5220.9D, "Quality Assurance and Revalidation of Training Systems"

—USAF, AFR 50-8, "Policy and Guidance for Instructional System Development"

—USAF, AFR 50-11, "Management of Training Systems"

—USMC, MCO, "Marine Corps Training and Audiovisual Support Manual"

III. POINTS OF CONTACT

Army: Training Directorate
(DAMO-TRP)
(202) 697-0853

Navy: Chief of Naval Operations
(OP-111E)
(202) 694-4971

Marine Corps: Training Department
(TAP-43)
(202) 694-1551

Air Force: Manpower, Personnel and Training
(AF/MPPTS)
(202) 695-7321

Other: Defense Training Data and Analysis Center
Orlando, Florida
(305) 281-3600

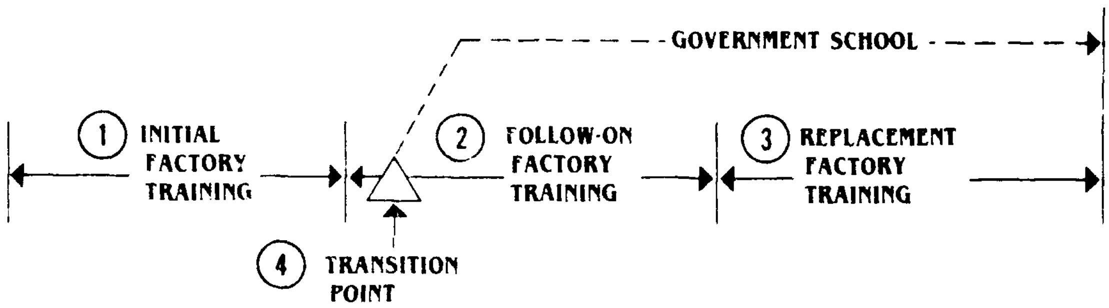
IV. PURPOSE AND SCOPE

Provide information on the development of training plans, as part of the integrated logistic support planning process.

V. DOD POLICY

It is DOD policy that manpower, personnel, and training (MPT), as essential elements of ILS, be given explicit attention early in the acquisition process. Principal activities required include determination and specification of requirements based on: previous experience with similar systems, demographic expectations, design trade-offs, and contractor incentives to meet MPT objectives.

Figure 1. TRAINING LIFE CYCLE



1. First, cadre, or nucleus group of personnel, as required for the test program or as instructors
2. Additional personnel required to man government installations
3. Personnel required to replace original personnel
4. (Transition point to government school, if one is established. If no school is established, use "initial factory," "follow-on factory," and "replacement factory.")

Training and Training Support includes the processes, procedures, techniques, training devices, and equipment used to train civilian, active duty, and reserve military personnel to operate and support a materiel system. This includes: individual and crew training; new equipment training; initial, formal, and on-the-job training; and logistic support planning for training equipment and training device acquisitions and installations.

VI. TRAINING REQUIREMENTS ASSESSMENT

Figure 1 shows a typical training life cycle for a DOD system. Planning and development of a training program for a major system acquisition should be conducted in concert with development of other elements of system support. Logistic support analyses to support training requirements can be performed as early as the concept demonstration/validation phase, in accordance with the guidance of MIL-STD-1388-1. During this phase, it is appropriate to perform a task and skill analysis (Task 401) in support of the ILS planning process.

The purpose of this task is to analyze required operations and maintenance tasks, and related skill levels, for the system/equipment, and provide source data for a variety of logistics documents, including training program, manpower, and personnel lists, technical manuals, etc.

The task analysis should consider such items as the classes of behaviors, conditions of performance, and the degree of proficiency required. A completed task analysis should include all the learning requirements necessary for the development of objectives for a training program. It is also known as "Skill Analysis" and "Job Task Analysis."

VII. TRAINING PLAN INTERFACE WITH ILS PLANNING PROCESS

Manpower requirements are developed and personnel assignments are made to meet mission support demands throughout the life cycle of a system. Manpower requirements are derived from such factors as the system/equipment configuration and related technical data, and are predicated on accomplishment of the mission in the most efficient and economical way. Personnel assignments are made to meet the manpower requirements with available resources. Manpower requirements must cover operational and maintenance requirements for the organization, intermediate, and depot levels at military and civilian facilities.

Figure 2: RECOMMENDED TRAINING PLAN OUTLINE

Acronyms

I. TECHNICAL PROGRAM DATA

A. Title Nomenclature
B. Security Classification
C. Training Plan Principals
D. Operational Uses
E. Operational/Technical Evaluation
F. System/Equipment Replaced
G. Description
H. New Features
I. Concepts
J. Logistics
K. Schedules
L. Manpower Requirements
M. Training Concepts

II. BILLET AND PERSONNEL REQUIREMENTS

A. BILLETS

1. Military Billets for Operational Units and/or Activities New Aircraft/System/Subsystem/Equipment
   a. Number of Billets Required Per Unit/Activity
   b. Aircraft/System/Subsystem/Equipment Ready for Operational Use Introduction Schedule
   c. Total Number of Billets Required for Operational Units and/or Activities by Fiscal Year New
   d. Total Number of Billets Required for Support Units and/or Activities by Fiscal Year New
   e. Total Operational and Support Billets New
2. Military Billets for Operational Units and/or Activities Old Aircraft Squadron/System/Subsystem/Equipment
   a. Number of Billets per Replaced Unit/Activity
   b. Aircraft Squadron/System Subsystem/Equipment Replacement (Phaseout) Schedule
   c. Total Number of Billets to be Replaced in Operational Units and/or Activities by Fiscal Year
3. Net Total Officer and Enlisted Support Billet Requirements
4. Training Activities Staff (Instructor/Support) Billet Requirements
5. Chargeable Student Billet Requirements
6. Net Annual Incremental and Cumulative Billet Increases/Decreases

B. PERSONNEL

1. Adjusted Annual Training Input Requirements Class A School Training
2. Final Adjusted Annual Training Input Requirements Skill Progression and Functional Training
3. Industrial, Foreign, Other Service, and Other Nonmilitary Personnel Annual Training Input Requirements
4. Reserve Personnel Mobilization Annual Training Input Requirements
5. Total Number of Instructor and Support Personnel Required for Training Activities
6. Aggregate Final Adjusted Annual Training Input Requirements to Attain and Sustain User Support, Nonmilitary, Foreign, Reserve Instructor, and Support Requirements

III. TRAINING REQUIREMENTS

A. Training Courses/Trainee Inputs

1. Initial Training
2. Follow on Training

IV. TRAINING LOGISTIC SUPPORT REQUIREMENTS

A. Training Hardware Requirements

1. Technical Training Equipment
2. Test Equipment
3. *Repair Parts for Technical Training Equipment*
4. Training Devices

B. Training Services/Material Requirements

1. Training Services
   a. GPETE/SPETE Resource Requirements
   b. Initial Training Resource Requirements
   c. Advisory Services Resource Requirements
   d. Curricula Materials Resource Requirements
   e. *Training Aid Resource Requirements*

C. Facility Support Requirements

V. TRAINING PROGRAM FUNDING

VI. MAJOR MILESTONES

VII. ACTIONS AND/OR DECISIONS REQUIRED

VIII. POINTS OF CONTACT

A task and skill analysis report is based on information contained in the Logistic Support Analysis Record (LSAR), and includes a separate set of narrative and tabular forms for each type of training requirement identified.

Training and training support defines the qualitative and quantitative requirements for training of operating and support personnel throughout the system's life cycle. The personnel addressed in this element include military and civilian requirements for instructors, and the development and support of training equipment (mockups, simulators, and training aids).

The training concept is developed in the integrated logistic support plan (ILSP) and should be discussed in detail in the training plan. The training plan should identify and describe the personnel skills required to operate and support a system/equipment; their recommended placement within current, revised, or new military occupational specialties (MOS); individual listing of duties and tasks; new or revised training requirements; and projected annual manpower requirements for system support.

Several categories of personnel must be identified, trained, and available when the system is scheduled for the initial operational capability (IOC). Billet requirements must be identified and funded for the following personnel categories:

—Installation technicians
—Operations personnel
—Maintenance technicians (including field maintenance agents)
—Supervisors
—Transportation personnel
—Security guards (if required).

Each of these categories of personnel may require:

—Training personnel/instructors
—Training programs
—Security clearances.

Each service must identify the personnel requirements and skill levels necessary for the system/equipment under all normal conditions of readiness. Operational manning and maintenance manpower requirements at all applicable maintenance levels must be addressed. Manning levels and schedules should be identified by maintenance level for each anticipated field site. It is necessary to identify all training courses required for installation, operation, and maintenance personnel, together with locations and duration of each course. Special training devices required for such courses at each location should be identified and procured.

VIII. TRAINING PLAN DEVELOPMENT

Figure 2 is a recommended training plan outline. It is included primarily for guidance purposes, and should be tailored to suit the needs of a specific program.

Part I is a summary overview of the system. It should provide sufficient information to familiarize the reader with key system and logistics features. Manpower requirements for user activities and training sites should be identified by location, number, and rate of personnel. The training concept should be set forth in detail. Goals of the training program should be clearly stated. Participating government and industry activities should be identified, together with specific courses and modules designated for the program.

Part II contains billet and personnel requirements for applicable units and activities. These can be effectively presented in tables by identifying 5-year requirements by rank/rate and MOS, with totals summarized at the bottom of each table.

Part III identifies requirements for initial training and follow-on training in tabular format by location, course type, length, total number of students, and fiscal year. This section should identify total student throughput.

Part IV sets forth support requirements for training hardware, as well as training devices and special material, together with related budget impact.

Part V contains training program funding requirements for the total program, including government and contract efforts.

Part VI lists major milestones and activities responsible for their accomplishment. Part VII lists open action items and decision requirements. Part VIII lists points of contact within all participating activities. Appendices may be included, where applicable, to provide more detail.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 5.3
Version: Updated
Date: December 1988

I. TITLE

Technical Manuals Acquisition Management

II. REFERENCES

—DODI 4151.9, "DOD Technical Manual Program Management," 4 February 1982

—AFLC/AFSCR 800-24/AMC 700-97/ NAVMATINST 4000.38/MCO P4110.1A, "Standard Integrated Support Management System," Chapter 16, 22 March 1984

—AFR 66-19/AR 310-71/NAVATINST 5600.11/ MCO 560.9/DSAR 4151.9, "Interserving of Technical Manuals and Related Technology," 6 December 1976

III. POINTS OF CONTACTS

Defense Materiel Specifications and Standards Office (DMSSO)
Falls Church, VA
(703) 756-2559; AV 289-2554

Headquarters, AF Logistics Cmd/MMAPD
Wright-Patterson AFB, Ohio 45433
(513) 257-6021; AV 787-6021

U.S. Army Material Readiness Support Activity
Lexington, KY
AV 745-3415

Naval Air System Command (AIR 04A4/NATSF-14)
Washington, D.C. 20361
(202) 692-9670; AV 222-9670

IV. PURPOSE AND SCOPE

This fact sheet is designed to:

—Describe the basic guidelines for implementing a Technical Manual (TM) Acquisition Management Program for systems acquisition.

—Be general in scope (service unique policies and practices are not described herein).

V. POLICY

Technical manuals are an integral part of system/equipment support requirements. They are the prime means of comunicating maintenance and operational information to the user. Manual requirements must be planned, progressively monitored and updated to ensure timely completion and delivery for adequate logistics support. Since the quality of TMs affects equipment maintainability, personnel efficiency, safety and readiness, quality in technical manuals must be a planned objective.

Each military service is responsible for budgeting and funding its TM requirement. On joint or multiservice programs, the military service assigned executive responsibility for a hardware development/acquisition program will ensure procurement of TM requirements of all particpating services. To ensure maximum utilization of all existing TMs, all services are responsible for reviewing the interservice technical information exchange system (ITIES) and the joint interest list of technical manuals.

Within the Department of Defense, TM management is under the direction, control and management of the under secretary of defense for research and engineering (USDR&E). The prime focal point within the USDR&E office is the Defense Materiel Specifications and Standards Office (DMSSO), which develops overall policies, procedures and standards for TMs.

VI. TECHNICAL MANUALS ACQUISITION

Responsibilities

The responsibility for the overall management of the TM program lies with the program manager (PM). Normally, the PM will designate a logistics manager (LM) to be responsible for the development and detailed management of integrated logistics support (ILS) for the equipment/system.

Acquisition Cycle

Prior to entering into a formal arrangement for a contractor to produce TMs, the government is responsible for furnishing guidance to the contractor for the development of a technical manual plan (TMP) as part of the integrated support plan (ISP). Initially, this is in the form of requirements reflecting only the general types of technical manuals required. The government will then convene a planning conference to review and approve the TMP prior to its inclusion into the ISP. After TMP approval the government will convene an initial technical manual selection conference to determine specific requirements for TMs. Subsequent specific requirements are then developed concurrently with the ISP.

The contractor has the responsibility of justifying and validating each manual recommended. Additional contractor responsibilities include providing engineering design, maintainability, and maintenance analysis documentation and assistance. Finally, the contractor updates the TMP to reflect all conference decisions.

Technical Manuals

The type of support planned for the specific system/equipment involved determines the types of technical manuals required. Technical manuals are prepared in accordance with appropriately tailored military specifications identified in the applicable data item description (DID).

Several DIDs apply to the technical management area:

DI-M-6153 Technical Manuals/Commercial Literature
DI-M-6154 Technical Manual Plan (TMP)
DI-M-6155 Technical Manual Status and Schedules
DI-M-6156 Technical Manual (contractor-furnished equipment (CFE) notices)
DI-M-6157 Technical Publications for Advanced Development Programs
DI-M-6158 Technical Manual Data Research and Analysis Source Data
DI-M-6159 Validation Record (Technical Manuals)
DI-M-6126 Report of Technical Manual Costs

These DIDs are program general and should be reviewed and tailored to the specific equipment systems of the program.

Technical Manual Plan

The TMP describes the general procedures, terms, and conditions for the planning, selection, preparation and delivery of technical manuals. In the TMP, the contractor documents the intended purpose and scope of each manual, and explains the interfaces and overlap between or among manuals. Some of the key items that the TMP must include are:

a. Plan. A description of the general plan for the technical manual program.

b. Procedures. A detailed description of the procedures to be used to ensure adequacy, accuracy, and clarity of data in the manuals.

c. Standardization. A detailed account of the procedures that will be used to achieve standardization among manuals. Particular emphasis should be placed on writing style, nonenclature, abbreviations, and symbols.

d. Specifications. The contractor should list all applicable specifications and identify any problems in interpretation/application.

e. Contractor Coordination. The contractor will explain the methods that will be used to manage the manual development of integrating and associate/subcontractors.

f. Manual Outline/Approval Procedures. An outline listing each paragraph title and a brief description of the content will be provided. Additionally, the contractor will describe the approval procedures to be used both internally and with the government.

g. Publication and Distribution Methods. The contractor describes procedures for preparing, reproducing, printing and distributing manuals.

h. Validation and Verification Procedures. A plan and appropriate procedures for validation and verification are described.

i. Transition Method. This section is for the contractor to outline how manual data will be transi-

tioned from the conceptual phase through the definition phase into the acquisition phase and training support.

A variety of other topics (including cost procedures, quality control, control of classified information, etc.) should be addressed. These are covered under DID DI-M-6154.

Technical Manual Reviews

There are three management processes basic to TM acquisition management: in-process reviews (IPR), contractor validation, and government verification. When appropriate, these reviews should be conducted as an integral part of the overall logistics support effort (for example, as part of the quality assurance effort, configuration management effort, during tests and audits, etc.)

a. In-Process Reviews. These reviews allow coordination between the government and contractor to ensure that the manuals are being prepared in accordance with the contract and appropriate specifications. Normally, the government initiates these reviews; however, the contractor may request IPRs whenever assistance is required. They are held at appropriate times prior to the production of the final product (e.g., 30 percent of manual completed, 70 percent completed.)

b. Contractor Validation. The contractor is tasked with providing accurate and adequate technical manual content for support of the system in accordance with the approved maintenance plan. Assurance that this is done is provided by the contractor's validation process. The contractor must develop and implement a validation plan that the government formally approves. It is normally submitted as part of the total TMP.

Validation is a continuing effort covering all manuals, changes and revisions. It is normally timed-phased for accomplishment during regularly scheduled production test and inspections. The contractor must give the government adequate notice to allow witnessing or participation in the validation. The process is then documented by the contractor, and the records made available for government review/certification. *All maintenance procedures must be validated unless waived by the government.*

c. Government Verification. Verification refers to the adequacy and accuracy of the manuals and is the responsibility of the government. Regulations only require the government to test and prove the adequacy and accuracy of selected manuals as determined by the PM. Verification is accomplished in accordance with individual service directives or specifications: (A) MIL-M-0038784, (N) MIL-M-81203 and NA-00-25-600, (AF) TO-00-5-1. The contractor may be requested to assist in this verification.

Material Retention

Throughout the life of the contract, the contractor is required to store and protect material used to create the final product. Material to be stored includes a reproducible copy, the artwork, master tapes and cards.

At the end of the contract the stored material for the latest issue of each manual still in existence will be delivered to the government. However, if the material is required for use on other contracts, the contractor can retain it provided written notice is given the government.

Contract Items

The basic phrasing of contractual requirements for TM acquisition can be found in Chapter 16 of AFLC/AFSLR 800-24. These are meant as guidance and should be reviewed and tailored to the specific equipment/systems of the program.

INSERT TAB 6

TEST AND EVALUATION

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 6.1
Version: Update
Date: December 1988

I. TITLE

The Test and Evaluation Master Plan (TEMP)

II. REFERENCES

—DOD Directive 5000.1, "Major and Non-Major Defense Acquisition Programs," 1 September 1987

—DOD Instruction 5000.2, "Defense Acquisition Program Procedures," 1 September 1987

—DOD Directive 5000.3, "Test and Evaluation," 12 March 1986

—DOD 5000.3-M-1, "TEMP Guidelines," October 1986, C1 5 February 1988

—DOD 5000.3-M-3, "Software Test and Evaluation Manual," November 1987

—Memorandum: Live Fire Test and Evaluation Guidelines, DAB T&E Committee, 1 June 1988

—DOD Directive 5141.2, "Director of Operational Test and Evaluation," 2 April 1984

—Army Regulation 70-10, "Test and Evaluation"

Air Force Regulation 80-14, "Test and Evaluation"

—OPNAVINST 3960.10C, "Test and Evaluation"

—Marine Corps Order 5000.11A, "Testing and Evaluation of Systems and Equipment for Marine Corps"

III. POINTS OF CONTACT

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Washington, D.C. 20331

Director, Operational Test and Evaluation
Office of the Secretary of Defense
Washington, D.C. 20310

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Deputy Under Secretary of the Army (OR)
Washington, D.C. 20310

Navy:
Chief of Naval Operations OP-983
Washington, D.C. 20350-9000

U.S. Air Force:
Assistant Secretary of the Air Force For Acquisition (SAF/AQV)
Washington, D.C. 20330

U.S. Marine Corps:
Marine Corps Research, Development and Acquisition Command
Director of T&E
Quantico, VA 22134-9000

IV. PURPOSE AND SCOPE

This fact sheet is designed to:

—Describe the Test and Evaluation Master Plan (TEMP)

—Be general in scope; consequently, service specific unique policy is not stressed and briefly covered

—Augment the TEMP discussion contained in DOD Directive 5000.3.

V. POLICY AND REQUIREMENTS

For major weapon system acquisitions, successful accomplishment of T&E objectives is a key requirement for decisions to commit significant additional resources to a program, or to move from one acquisition phase to the next. Successful accomplishment of T&E objectives includes testing system performance in a realistic environment including a rigorous assessment of critical performance, as well as adversary-type testing when realism requires it.

Acquisition schedules, financial plans, and contractual arrangements are based upon this requirement.

The Secretary of Defense designates those systems classified as major weapon system acquisitions. For major acquisitions the component prepares and submits a test and evaluation master plan (TEMP) in accordance with DOD Directive 5000.3. Other, less than major systems, with higher than usual interest, can also be identified and required by either the Director of Operational Test and Evaluation (DOTE) or by the Deputy Director of Defense Research and Engineering (Test and Evaluation) (DDDRE(TE)) to submit TEMPs. All other programs are guided by principles of DOD Directive 5000.3. However, each component has latitude and flexibility concerning its own TEMP requirements for less than major systems including submittal times, update frequency, format, and content.

The TEMP is a broad, top-level plan detailing all major test and evaluation events, and is a primary document used in the OSD major weapon system acquisition review and decision process. The TEMPs should define how the component will accomplish the planned testing and evaluation in order to support major program decisions; identify special T&E resources and requirements to facilitate long-range planning; and document major agreements. A program's first TEMP is submitted in support of the DAB for Milestone I and updates must occur before each subsequent decision milestone. However, as a result of the decision process, additional updates may be required annually or at other intermediate intervals. The format, length, and content of the TEMP are specified in DOD Directive 5000.3-M-1 TEMP Guidelines.

Every TEMP submitted to OSD should contain the same kinds of information, and the specified format should be adhered to as closely as possible. Although system complexity may dictate TEMPs of different length and content, a TEMP submitted to OSD should be a summary document, containing adequate details to show the rationale for the kind, amount, and schedules of the planned testing. The TEMP must relate the T&E effort clearly to technical characteristics, technical risk, operational issues and concepts, system performance, reliability, availability, maintainability, logistics requirements, and major decision points. It must explain the relationship of the various simulations, subsystem tests, integrated system development tests, and initial operational tests which, when their results are analyzed, provide confidence in the system's readiness to proceed into the next phase of development, or into production and operational service.

The TEMP addresses the T&E to be accomplished in each program phase, with the next phase addressed in the most detail. The TEMPs supporting the production and initial deployment phase must include the T&E planned to verify correction of deficiencies, production acceptance testing, and follow-on test and evaluation.

The program's first draft TEMP may be submitted to the DDDRE (TE) for OSD coordination, review and comment. The draft TEMP is submitted concurrent with the "for comment" acquisition decision documentation 90 days before the planned Milestone I date. After review by the OSD staff elements the draft will be revised if necessary, and then the service approved TEMP is submitted for OSD approval at least 15 working days before the DAB meeting or decision milestone data, if a DAB meeting is not planned). Before either Milestone II or III, the TEMP will be updated and submitted in accordance with these procedures. Either TEMP approval or TEMP redirection will be provided by OSD following each decision milestone.

When a program's test objectives are satisfactorily resolved, including the verification of deficiency corrections, the service may recommend to OSD that the annual TEMP submission requirement be terminated.

VI. BACKGROUND

The TEMP covers the program life cycle from initiation through the post-deployment phase. It is prepared as early as possible in the acquisition process, and designed to identify and integrate objectives, responsibilities, resources, and schedules of all tests, evaluations or assessments to be accomplished in support of the system development and decision processes. The TEMP describes the amount and types of testing to be conducted, consequently, it reflects and expands upon the program performance requirements defined in parallel Program Documents (MNS, SCP, DCP, BASELINE).

The TEMP facilitates long-range planning by identifying special T&E resources and requirements and documenting major agreements between the material developer and the independent operational test and evaluation agency.

VII. TEMP FORMAT

The TEMP's five-part format is specified in DOD Directive 5000.3-M-1. The specified format is briefly outlined as follows:

Part I - System Details

1. Mission Description.
2. System Description.
3. Required Technical Characteristics
4. Required Operational Characteristics

Part II - Program Summary

1. Management.
2. Integrated Schedule.

Part III - DT&E Outline

1. Critical Technical Characteristics.
2. DT&E to Date.
3. Special Requirement for System/Subsystem Retest.
4. Future Date.

Part IV - OT&E Outline

1. Critical Operational Issues.
2. OT&E to Date.
3. Future OT&E.

Part V. - Test and Evaluation Resource Summary

1. Test Articles.
2. Test Sites and Instrumentation.
3. Test Support Equipment.
4. Threat Systems.
5. Test Targets.
6. Operational Force Test Support.
7. Simulators, Models, and Testbeds.
8. Special Requirement.
9. T&E Funding Requirement.
10. Resource Schedule.
11. Manpower/Training.

VIII. TEMP CONTENT

The TEMP is a dynamic document with contents that should be factual and specific, avoiding generalities and emphasizing quantifiable and testable requirements, both operational and technical. It is imperative that pertinent, but integrated, facts and descriptions be included. The contents must describe the amount and type of testing to be conducted before each milestone, and the resources required. The program manager is responsible for developing the TEMP, including all its contents and its preparation. Part IV concerns the operational T&E and the DOD components usually require the independent operational test and evaluation organization (sometimes designated the operational test director, OTD) to be responsible for its preparation, contents, and coordination. Therefore, the program manager must establish early liaison with the operational tester to assist the OTD with integration of OT&E requirements into TEMP. This integration is frequently done using a test planning working group consisting of a representative for each player in the testing program.

In-depth explanation of each part of the TEMP is provided in DOD Directive 5000.3-M-1. Staff officers at DDDRE(TE) and DOTE will provide assistance upon request.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 6.2
Version: Update
Date: December 1988

I. TITLE

Development (DT&E), Operational (OT&E), and Production Acceptance (PAT&E) Test and Evaluation

II. REFERENCES

—DOD Directive 5000.1, "Major and Non-Major Defense Acquisition Programs," 1 September 1987

—DOD Instruction 5000.2, "Defense Acquisition Program Procedures," 1 September 1987

—DOD Directive 5000.3, "Test and Evaluation," 12 March 1986

—*Systems Engineering Management Guide*, DSMC, December 1986

—*Test and Evaluation Management Guide*, DSMC, March 1988

III. POINTS OF CONTACT

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U.S. Marine Corps:
Marine Corps Research, Development and Acquisition Command
Director of T&E
Quantico, VA 22134-9000

IV. PURPOSE AND SCOPE

This fact sheet is designed to provide information on the use of test and evaluation (T&E) functions during the system development process.

V. DOD POLICY AND REQUIREMENTS

Test and evaluation is to begin as early as possible in the acquisition cycle and continue throughout the systems acquisition process. The purpose of all T&E is to make a direct contribution to the timely development, production, and fielding of systems that meet the user's requirements and are operationally effective and suitable.

—Successful accomplishment of test and evaluation objectives is a key requirement for decisions to commit additional resources to a program or to move from one acquisition phase to the next.

—Dependence on subjective judgment concerning performance shall be minimized during testing.

VI. TEST AND EVALUATION

The DOD T&E policy explicitly states the importance of using T&E as a measure of the progress of technical and operational performance of a weapon as it matures during the acquisition process. In addition, the policy implicitly states that T&E can, and should, be used to assist in the development process.

The standard testing cycle can be considered to consist of the following four activities:

—Identification of issues and criteria
—Measurement of performance
—Comparing actual with expected performance
—Taking corrective action.

Issues and criteria are developed from operational requirements and performance thresholds and goals found in early program documents, such as the Mission Need Statement (MNS), the System Concept Paper (SCP)/Decision Coordination Paper (DCP) and baseline documents.

Measurement consists of data collection activities, including field test, test beds, and simulations that are designed to evaluate the conformance of system components with standards of performance or to recognize the deviations. Test and evaluation is an iterative process of measurement, analysis of feedback, corrective action and retest.

The DT&E and OT&E are integral events in the acquisition of a weapon system. The structure and timing of these tests can be used to measure technical and programmatic risk.

The PAT&E, while generally associated with the verification of contractual specifications and requirements, provides a feedback mechanism for modifying/correcting manufacturing processes to enhance quality of production.

The overall program schedule must allow time for T&E but schedules could be risky if the results of T&E identify significant performance deficiencies. Enough time should be available between testing and decision-making that the evaluation and corrective action can be formulated.

VII. TYPES OF TEST

Development Test and Evaluation (DT&E)

The DT&E is conducted by the contractor and the program manager to assist in the engineering design and development process. The DT&E emphasizes the use of controlled conditions and well-trained operators and maintainers. While the goal of DT&E is to verify attainment of technical performance specifications and objectives, feedback from the DT&E activity provides a meaningful input to the risk assessment and decision process. The assessment function of DT&E can be enhanced by using an incremental approach whereby parts and subassemblies are subjected to test, followed by a progression to more complex components and subsystems to final systems test. Development testing is conducted over a range of conditions intended to exceed the design limits to identify marginal performance limits.

Phases of Development Test and Evaluation

—The DT&E is conducted in concept exploration/definition to assist in selecting preferred alternative system concepts and to support the decision to advance to the concept demonstration/validation phase (Milestone I (MS I)).

—The DT&E is conducted during concept demonstration/validation to identify preferred technical approaches to include identification of technical risks and feasible solutions. Normally, it is conducted on early prototype equipment at component and subsystem level, up to and including employment of full-scale engineering models. This test supports the decision to advance to the full-scale development phase (MS II).

—The DT&E is conducted during full-scale development to ensure that engineering is reasonably complete, all significant design problems are identified and that solutions are in hand. The DT&E demonstrates integrated system performance and will make input to the maturation process of the system in meeting its performance specifications, reliability, maintainability, supportability, safety, survivability and other appropriate engineering specialty goals. The results are used to support the decision to advance to the full rate production/deployment phase (MS III).

—The DT&E continues to be conducted during production and deployment. The thrust here is to verify that product improvements, or corrections of design deficiencies discovered during operational test and evaluation (OT&E) are effective.

Test, Analyze and Fix (TAAF)

This is an example of DT&E designed to stress the item or system under test, thereby causing failure at the weak links. Deficiencies induced can then be corrected with the intent to enhance the overall reliability of the system. Testing should start at part level and work up to the overall system test. The TAAF process will assist in establishing confidence in design margins and identify or eliminate failure modes.

Operational Test and Evaluation (OT&E)

The OT&⁻ 's conducted by an independent Operational Testing Agency (OTA) to estimate a system's operational effectiveness and suitability. Performance tradeoffs between engineering design and cost can be evaluated. As decisions are reached regarding trade offs, they become input to the process of developing system and subsystem performance specifications. The OT&E should be accomplished in an environment that is as operationally realistic as possible. Typical operator and support personnel are used during OT&E to obtain a valid estimate of user capability to support and use the system. System contractor personnel are prohibited from supporting OT&E which lead to a production decision.

Phases of Operational Test and Evaluation

—Early operational assessments are conducted during concept exploration/definition to assess operational impacts of candidate technical approaches and to assist in selection of preferred system concepts. Early operational assessments support the MS I decision.

—The OT&E is conducted during concept demonstration/validation to examine operational issues for the selected alternative approaches and to estimate potential operational effectiveness and suitability of candidate systems. Assists in identifying operational performance trade-offs. Supports the MS II decision and any required decisions concerning commitment of funds for long lead items or the use of Low Rate Initial Production (LRIP).

—The OT&E is conducted in a realistic tactical environment during full-scale development to provide a valid estimate of the system's operational effectiveness and suitability. Systems tested must be representative of the expected production item. Supports the MS III decision. A recommendation/ statement concerning the system's readiness for operational use must be made at this point by the Director of Operational Test and Evaluation; it may be beyond LRIP report.

—After production, follow-on operational test and evaluation may be conducted, as necessary, to ensure that: modifications to the production item meet operational effectiveness and suitability requirements; faults found during FSD OT&E have been fixed; to assist in development of new tactics and doctrine.

Production Acceptance Test and Evaluation (PAT&E)

Test and evaluation of production items to demonstrate that the produced items will fulfill the requirements and specifications of the procuring contract or agreement. The program office and the contract administration service responsible must be prepared to conduct PAT&E. Complexity of the system will determine the level of effort and support required to ensure adequate acceptance testing. Acceptance testing results, as well as being measures of compliance, may provide meaningful information relative to the effectiveness of the process control of production. Production quantities dictate whether PAT&E is conducted on each item or through random sampling of minimum quantities.

VIII. PLANNING AND REPORTING

Testing should be planned to assist in the engineering and devleopment of the system. Results of tests conducted must be analyzed and improvements/fixes fed back into the development cycle to avoid expensive repetitive testing without correction of the problem or process. For issues and criteria to be established in the testing process, standards of performance must be predetermined for use in measuring actual accomplishments. The establishment of standards or test criteria is closely related to the development of test issues for each phase of testing. Before MS I, a Test and Evaluation Master Plan (TEMP) must be prepared. This broad plan shall relate test objectives to required system characteristics and critical issues, and integrate objectives, responsibilities, resources and schedules for all test and evaluation to be accomplished.

Effective T&E involves correlation of data collection activities in an integrated reporting system that is accurate, objective, fast and action-directed. Test and evaluation findings must be reported in a timely manner. Quick look analysis and automated real time data reduction should be used to expedite reporting of important results. Integration of contractor, developer, and operational testing results into a coordinated data base will assist in trend analysis and risk reduction.

INSERT TAB 7

PRODUCTION MANAGEMENT

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC Technical Management Department
Number: 7.1
Version: Update
Date: December 1988

I. TITLE

Production Planning

II. REFERENCES

—DODD 5000.1, "Major and Non-Major Defense Acquisition Programs," September 1987

—DODD 5000.3, "Test & Evaluation"

—DOD 4245.6, "Defense Production Management," January 19, 1984

—DOD 4245.7, "Transition from Development to Production," January 1984

—DODD 4245-M, "Transition from Development to Production," September 1985

—DODD 4200.15, "Manufacturing Technology Program," July 14, 1972

—DODD 4005.1, "DOD Industrial Preparedness Production Planning," July 28, 1972

—DODI 5000.38, "Production Readiness Reviews," January 24, 1979

—DODI 5000.XX, "Producibility Assessments," (Draft in work) planned release, late 1988

—MIL-STD-1528

III. POINTS OF CONTACT

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Headquarters, U.S. Army Materiel Command (AMCMT-P)
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(202) 272-8284/5; AV 284-8284/5

IV. PURPOSE AND SCOPE

This fact sheet is designed to:
—Describe production planning from the government program manager's point of view
—Describe the relationship of production planning to the acquisition strategy and acquisition plan
—Provide a planning outline
—Be general in scope; i.e., service unique policies and practices are not stressed herein.

V. PROGRAM MILESTONE REVIEWS. Production management shall be addressed specifically at each program milestone decision point in the major system acquisition process.

Milestone 0 - Concept Exploration/Definition. Concepts generated by the design/user/production team should consider manufacturing processes and standardized parts as early as possible in this phase. Early involvement by the team is essential to later milestone success.

Milestone I - Concept Demonstration/Validation. Production feasibility of candidate system concepts shall be addressed and areas of production risk defined. Manufacturing technology needed

to reduce production risk to acceptable levels shall be identified. Preliminary goals and thresholds for industry base capability shall be formulated based on an industrial resource analysis (IRA).

Milestone II · FSD. The producibility of the design approach shall include provisions to attain producibility of the production design using cost-effective manufacturing methods and process. Production decisions shall be supported by an assessment of the program readiness for production during FSD based on a formal production readiness review (PRR). The PRR shall include asessing the results of PEP and manufacturing technology activities. Resource requirements for producibility engineering and planning (PEP), long-lead procurements, critical materials, labor skills, facilities, equipment, and limited production unit cost, schedule, and surge requirements shall be confirmed at the prime and key subcontract levels.

Milestone IIIA · Low Rate Initial Production (LRIP). The LRIP may be used to confirm processes, reduce risk, provide first article candidates, and demonstrate design stability.

Milestone III · Full Rate Production and Deployment. Plans and provisions for accomplishing cost reduction during production shall be described. Figure 1 provides a representative list of the production management activities through the system acquisition life cycle.

Milestone IV · Phased in P³I. Downline production quality verification and qualification.

Milestone V · Five to ten year review of current operational effectiveness and supportability. Production block upgrades may be evaluated or the system may be phased out.

VI. PROGRAM INTEGRATION

—It is essential that results of production strategy/planning be thoroughly integrated into the overall program strategy/plan and be reflected in the program structure. Appropriate allocation of program time, funding and management must be emphasized. Program management office manning and skill levels must be equal to the production management tasks at hand.

—The program manager must ensure that technical elements of the program (systems engineering, test and evaluation, production and integrated logistics support) are keyed together to

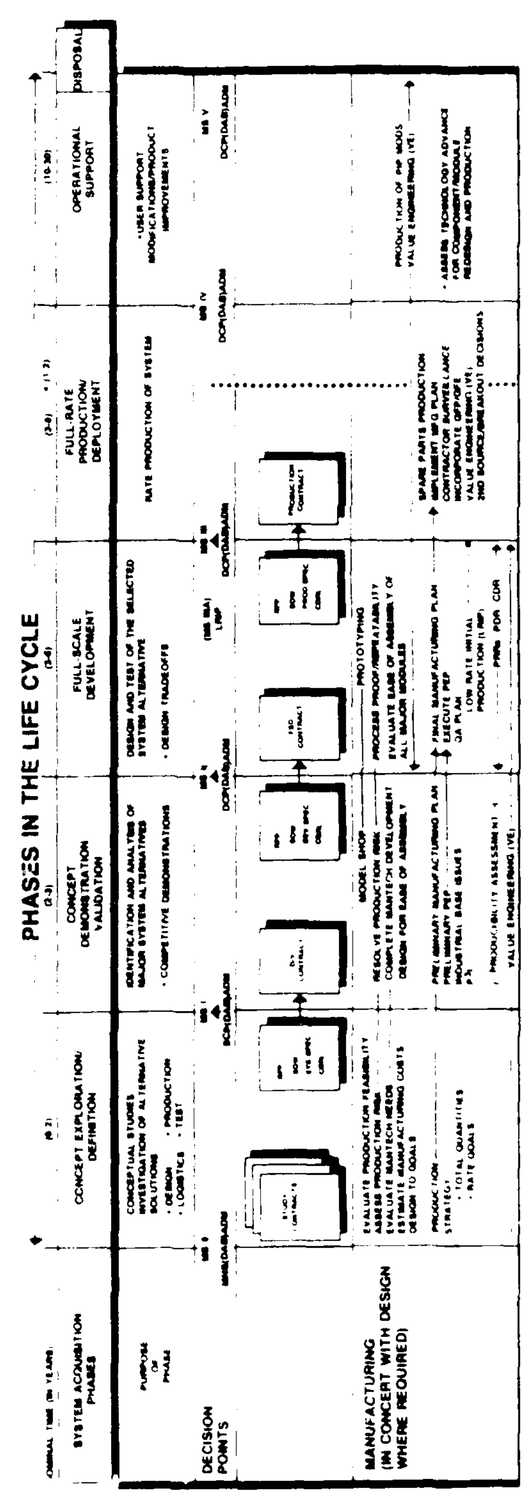

Figure 1. SYSTEM LIFE CYCLE TECHNICAL ACTIVITIES

accomplish overall program objectives. Consistency of technical approach within and among the various elements is essential to prevent one element from detracting or interfering with another.

—The program manager must develop techniques to manage the production aspects of the program. In doing so, maximum use must be made of existing management mechanisms such as engineering reviews, program reviews, testing programs, etc. The program management plan should serve as the prime tool to focus the overall management effort and avoid duplication.

—Special consideration should be given to staff requirements, organization structure and outside support. Requirements for managing the production aspects of the program should be stated.

VII. PRODUCTION MANAGEMENT

—Fundamental to DOD production management is the early development of a production strategy as part of the program's acquisition strategy. To a large degree, production considerations drive the material development process. Quantity and rate have a fundamental bearing on the system design. Performance, to a high degree, dictates materials that, in turn, dictate manufacturing technology that determines allocation of time and capital investment. These considerations have a major influence on the feasibility and timing of such fundamental acquisition strategy issues as competition and the various means of reintroducing competition; e.g. breakout and multiple sourcing. A thorough analysis of the production management tasks to be performed throughout the material development cycle is essential to the overall structuring of the program. Program phasing (schedule), funding, and management resources must be based on the initial planning.

—A Production strategy must be developed as part of the program acquisition strategy. This strategy should be based upon a comprehensive assessment of production issues. Figure 2 offers a logical outline around which a production strategy and subsequent plan can be developed. Attachment 1 provides a brief expansion of this outline and along with DOD 4245.7M "Transition From Development to Production," will provide a useful guide for the development of a program production strategy plan.

Figure 2. PRODUCTION STRATEGY/PLAN DEVELOPMENT OUTLINE

1. Program Production Objective
   a. Requirements
   b. Additional Program Needs
2. Production Facility Requirements
   a. Existing Industrial Base
   b. Government Furnished Facilities
   c. Contractor Facilities/Capital Investment
   d. Facilities/Equipment
   e. Labor
   f. Design Changes
   g. Producibility
3. Production Program Phasing
   a. Production/Delivery Schedule
   b. Economic Production Rate/Planned Production Rate
   c. Build-up Rate
4. Production Risk Analysis
   a. Management
   b. Materials/Purchased Parts
5. Producibility Engineering and Planning
   a. Design Producibility
   b. Resource Planning
      (1) Funding Controls
      (2) PEP Objectives
      (3) Work Scope
      (4) Allocation of Human Resources
      (5) Data Items
      (6) Time/Fund Allotment
6. Contractual Consideration
   a. Statement of Work
   b. Incentives
   c. Consistency Within and Among Contracts
7. Government Support to Contractor
   a. Government Furnished Equipment/Material
   b. Exemplary Facilities Survey/Award
8. Production Management Scheme
   a. Program Staffing
   b. Plant Representative Office
   c. DOD Research and Development Laboratories
   d. Consultant Support
   e. Other Government Team Participation

VIII. PRODUCIBILITY ENGINEERING AND PLANNING (PEP)

The term, "producibility engineering and planning," as used in DOD is identical to the term, "production planning," in the academic and industrial worlds. The PEP includes all those design activities and disciplines necessary to design a product that is producible, design the processes and tooling, set up the manufacturing facility and prove out the processes and facilities before entering production. The PEP must lead to a stable design as the program progresses into LRIP and for Full Rate Production/Deployment (FRP/D).

—DOD policy states that a comprehensive PEP program is requisite to entering FSD. The PEP program begins as an integral part of the design process and is conducted throughout FSD. It contains specific tasks, measurable goals and a system for contractor accountability.

—Program managers are to make assessments of production risk throughout the acquisition process. These assessments shall be formalized by reviewing the design process as a team effort through the established design review and audit mechanism, industrial resource analysis, and production readiness reviews.

—Contractor approach to the fundamental engineering principles and relevant technical disciplines (to include elements of producibility of design, preparation for production, production management capability, quality history, and potential to execute the production program) shall be among factors included in the contractual solicitation and evaluated thereafter in source selections. If a contractor attains exemplary facility status, the PMO/contractor interface is greatly enhanced.

—The PEP includes actions required to maintain a capability to produce material for the operation and maintenance of equipment after the production plan is complete. The planning for these post-production activities starts in the development phase and is a part of the Total Quality Management (TQM) process.

IX. POLICY

—It is DOD policy to plan for production early (as early as concept exploration/definition) in the acquisition process and to integrate acquisition actions to ensure an orderly transition from development to cost effective rate production.

—Key to achieving this objective is the rigorous application of fundamental engineering principles and relevant technical disciplines during development and production. Assessment of production risks shall be made throughout the acquisition process with a prime goal of design stability during production.

—Program technical balance consistent with (but not subordinate to) funding, schedule and other considerations shall be maintained.

—The modernization and improvement of industrial facilities shall be actively supported and encouraged by innovative arrangements. A payback on invested capital must be demonstrated.

—An adequate number of technically qualified and competent people must be committed to the program.

X. OTHER PLANNING GUIDANCE

An acquisition may not proceed into production until it is determined that the principal contractors have the physical, financial, and managerial capacities to meet the cost and schedule commitments of the proposed procurement. An assessment shall be made of contractors' capabilities to meet surge (peacetime) and mobilization (declared national emergency) requirements, and their commitments to participate in the DOD industrial preparedness production planning program under DOD Directive 4005.1. Competition, value engineering, tailoring of specifications and standards, streamlining, design-to-cost, cost benefit and trade-off assessments, preplanned product improvements, multiyear procurement, industrial modernization incentives, training in and practice in the use of the tools of TQM, and other techniques shall be used, as appropriate, to reduce production, operating, and support costs. Standardization, commonality, and interchangeability shall be promoted throughout the acquisition cycle to reduce lead time and life-cycle cost.

Technical data packages shall be developed and proved by means of production demonstration (including LRIP where rates of several systems per month are planned) and configuration audit, consistent with competition intelligent component break-out, and reprocurement objectives.

Production management planning and implementation shall include provisions for measuring progress in meeting design-to-cost and life-cycle cost commitments.

XI. DEFINITIONS

—Industrial Resource Analysis (IRA). A discrete analysis of industrial base capabilities conducted to determine the availability of production resources required to support a major system production program. These resources include capital, materiel, and manpower required to accelerate and maintain full production rates and respond to surge and mobilization requirements. The IRA includes results of feasibility studies, producibility analyses, and manufacturing technology program assessments.

—Producibility. The relative ease of producing an item or system. This factor is governed by characteristics and features of a design that enable economical fabrication, assembly inspection and testing using available production techniques.

—Producibility Engineering and Planning. The production engineering tasks and production planning measures undertaken to ensure a timely and economic transition from the development to the production phase of a program.

—Production Engineering. The application of design and analysis techniques to produce a specified product including:

—The functions of planning, specifying, and coordinating the application of required resources

—Performing analyses of producibility and production operations, processes, and systems

—Applying new as well as conventional manufacturing methods, tooling, and equipment

—Controlling the introduction of engineering changes to obtain design stability

—Employing cost control techniques.

—Production Feasibility. The likelihood that a system design concept can be produced using existing production technology while simultaneously meeting quality, production rate, and cost requirements.

—Production Management. The effective use of resources to produce, on schedule, the required number of end items that meet specified quality, performance, and cost. Production management includes, but is not limited to, industrial resource analysis, producibility assessment, producibility engineering and planning, production, industrial preparedness planning, post production planning, and productivity enhancement.

—Production Readiness. The state or condition of preparedness of a system or program to proceed into production. A system is ready for production when industrial resource capacity, completeness and producibility of the production design, and the managerial and physical preparation necessary for initiating and sustaining a viable production effort have progressed to the point at which a production commitment can be made without incurring unacceptable risks to the thresholds of schedule, performance, cost, or other established criteria.

—Critical Design Review. Firms up the technical data package and provides cost/schedule/responsibility to resolve open design issues. Production personnel must be present at these reviews and have equal influence over design issues relating to the production process.

—Production Readiness Review. A formal examination of a program to determine the design is ready for production, if production engineering problems have been resolved, and if the producer has accomplished adequate planning for the production phase.

—Productivity Enhancement. The use of contract incentives and other techniques to provide the environment, motivation, and management commitment to increase production efficiencies.

Attachment 1. PRODUCTION STRATEGY/PLAN, DEVELOPMENT OUTLINE

1. Program Production Objective. The production objective of any program must be thoroughly defined from the very beginning. The objective may range from merely managing a one-time, short production run to an extremely complex situation that requires initial industrial base facility expansion, significant industrial productivity improvement, or

potential long-term production deliveries. Facility moves or expansions should be discouraged once production has commenced.

a. Requirements. The production objective will address the total production requirement envisioned for the program. The production requirement will, of necessity, dictate the manufacturing process design as well as the method of employing facilities, tooling, and personal resources to be used by the prime and subcontractors.

b. Additional Program Needs. The production objective and total requirements in terms of deliveries of end items, spare parts, and contractor depot support will be identified. Actual and potential facilitaization needs, industrial base expansion, capacity for surge/mobilization, and productivity improvement considerations must be considered as appropriate.

2. Production Facility Requirements. Once the production objective and total requirements have been determined, an assessment of the existing industrial base must be made to determine the production facility requirements that are needed to execute the total production requirement. This portion of the plan for production must address activities necessary to determine facility requirements and how these facilities will be acquired and managed to accomplish the overall production objective.

a. Existing Industrial Base. The means for evaluating the existing industrial base, both government and contractor owned, should be addressed. This activity may take the form of a government study group, the tasking of a Service agency/command to make an evaluation a separate study contract with an outside firm, and/or as an integral part of the contracting for the end item. When required additions to the industrial base have been determined, the source of these additions must be planned for and identified. Early planning effort must identify what is expected of the contractor and what is expected of the Service.

b. Government Furnished Facilities. If the determination is made that government-furnished facilities are to be provided, the rationale for taking this approach, along with the scope of government facilitization involvement, including funding, should be discussed. A time-phased plan for implementing the government facilitization effort should be included. The plan should cover the schedule for project definition, the initiation of effort, and the justification required to obtain necessary funding at the appropriate time.

c. Contractor Facilities/Capital Investment. If the determination is made that the contractor is to furnish the facility additions, the contractor's proposed means of accomplishment must be identified and outlined. Contractor investment incentives and specific motivational tools must be explored early to induce the contractor to invest. Such considerations as termination buy back, the capital investment incentive clause, and cooperative approaches as industrial productivity improvement programs are available to this end.

d. Facilities/Equipment. Uncertainty in the extent and adequacy of facilities and equipment required to produce desired yields must be addressed. This includes buildings, utilities, manufacturing and test equipment, tooling, transportation capability, etc. Specific examples include new manufacturing facilities, equipment availability for balanced production lines, equipment necessary to achieve intended/planned production rates, and optional production line layout necessary to ensure surge/mobilization capacity. Capital equipment payback analysis should be performed to ensure that major equipment acquisitions are sound.

e. Labor. The availability of adequate direct and support production personnel must be analyzed. Factors requiring such analysis include labor availability, demand for scarce skills, training requirements, engineered labor standards (ELS), and personnel turnover in specific education/hard skills.

f. Design Changes. Assess uncertainty associated with the translation of design efforts into a successful production design; e.g., changes from design prototypes to production models, and the likelihood of content design problems associated with the latest test results.

g. Producibility. Uncertainty associated with the producibility of the development design must be evaluated and production risk reduced to acceptable levels by the joint efforts of design and manufacturing. Consideration must be given to the sophistication of the manufacturing process required, any new or untried processes, scale

changes, and/or the need for soft and hard tooling to physically produce the end item during full-rate production.

Note:

The production risk analysis should identify specific areas that should be addressed by both the contractor and the government. The risk analysis should be a basis for time/fund allotment, work-scope development and for structuring the production management scheme.

3. Production Program Phasing. The purpose of this portion of the plan for production is to ensure that proper time relationships are established among the overall program development and specific production events/milestones that will occur. This is done to ensure compatibility of subsequent planning and scheduling.

a. Production/Delivery Scheduling. The contractor must schedule all the steps necessary in the production process, from design to delivery. The scheduling must reflect the most logical and economical process available, consistent with program requirements. The scheduling process involves identification and integration of the workers, purchased material and parts, and machines and facilities necessary to complete and deliver the product as contractually required. Overall program phasing must be compatible with these production scheduling and phasing circumstances.

b. Economic Production Rate/Planned Production Rate. The economic production rate is that rate at which unit cost does not decrease significantly with any further rate increase. Economic production rates will be specifically considered in all production planning efforts and will provide the basis for structuring program schedules and budget profiles. If the planned production rate of a program is structured at other than economic rate, the circumstances for such structuring must be explained and justified. This justification will include the rationale used and will specifically address additional costs incurred as a result of producing at other than the economic production rate.

c. Build-up Rate. Planned build-up rates should be based primarily upon projections of design stability. Engineering change activities must be kept to an absolute minimum in production as it is a major element in controlling cost, protecting quality and maintaining delivery schedules. Other elements that should be addressed when determining build-up rate are tooling availability, process qualification schedules, subcontractor/vendor ability to provide components, and other operational and support factors. Therefore, these factors should be addressed in this portion of the plan.

4. Production Risk Analysis. Production risk analysis is a supporting tool for service and contractor decision-making. It seeks to estimate the probabilities of success or failure associated with the manufacturing alternatives available. Those risk assessments may reflect alternative manufacturing approaches to a given design, or may be part of the evaluation of design alternatives, each of which has an associated manufacturing approach. An assessment of production risk must be disclosed to support the preparation for, and structuring of, the production effort. This portion of the plan for production should identify and quantify, as appropriate, design stability, production areas/considerations having more than a normal risk value. Following are examples of categories requiring assessment.

a. Management. An analysis of the uncertainty in the organizational or management environment as related to the program must be made. The analysis should consider organizational turbulence brought on by manpower or dollar cuts, turbulence caused by establishing management capability in a new geographic location and/or a new facility, and uncertainty occasioned by unknown or soft program or requirements. The effectiveness of management systems should be considered.

b. Material/Purchased Parts. The risk associated with uncertainty in acquiring and using raw materials, and the uncertainty of vendor, subcontractor, and GFE performance must be addressed. Examples include long lead items, turbulence in specialized vendor industries, and material changes driven by emerging technologies.

5. Producibility Engineering and Planning (PEP). The purpose of PEP is to ensure that material designs reflect good producibility considerations before release for manufacture. The PEP measures include engineering tasks undertaken to ensure a timely and economic transition from the development phase to the production phase of a program. The PEP covers all activities from the

development of a producible design to the development of the manufacturing process, to activities required in preparation for actual production. For purposes of planning for production, it is necessary to consider "design producibility" and "resource planning" separately.

a. Design Producibility. The engineering discipline introduces producibility as an essential part of the initial system design process. It is the interactive process whereby necessary production/producibility considerations are incorporated early into the system design. Specific requirements for integration of producibility considerations in the design process should be addressed. These producibility goals, objectives, and requirements should be expressed in a sufficiently clear manner to be usable as part of the contractual work scope. The design producibility requirements will provide the basis upon which to evaluate the contractor's progress/accomplishment toward the producibility objectives.

b. Resource Planning. Functions necessary for the preparation for production normally associated with PEP (excluding what has been previously described as design producibility) should be addressed under this portion of the plan. Specific areas that should be considered include:

(1) Funding Controls. The entire PEP effort is funded as part of the research, development, test and evaluation program. It is important that the funds allocated for PEP should be used for that purpose and not disbursed for other efforts under the guise of PEP.

(2) PEP Objectives. Well-defined and measurable.

(3) Work Scope. The PEP objectives and how it is to be accomplished must be spelled out in definitive terms within the solicitation/contract. To the degree possible, this definitive description of the PEP effort should be part of the plan for production. It should provide the basis for proposal evaluation, negotiations as necessary, source selection and, ultimately, management and evaluation of the total PEP effort.

(4) Allocation of Human Resources. The planned allocation of personnel dedicated to the PEP effort by the contractor and the service should be addressed. During subsequent planning and contract definitization, care should be taken to ensure that changes to these resource levels are commensurate with the level of PEP effort required.

(5) Data Items. Such things as production plans, status reports, and other production management tools that are to be acquired should be addressed in the plan. These data items/management tools should be mutually supportive and commensurate with the overall production management approach.

c. Time/Fund Allotment. The overall PEP effort must allocate sufficient time, funds, and management resources to achieve the desired producibility results. Management's commitment toward producibility can only be gauged by its willingness to allocate time and resources. Time, funding, and management resources should be described in terms of off-line design trade-off studies, design process requirements, and contractual data items.

6. Contractual Considerations. A program's goals and objectives should be thoroughly integrated into the contractual structure of the program. Production considerations like production risk, government facilitization, capital investment, requirements, producibility, etc., should directly influence the approach to be taken with regard to contract type, terms, and conditions. The plan for production should identify those production considerations and outline how they are to be accomplished through the contract.

a. Statement of Work. The plan for production should address production tasks, goals, and objectives that are to be accomplished during the performance of the contract at the appropriate phase of the cycle. They must be described in sufficient detail and clarity to be suitable for incorporation into the statements of work of the contract. The need for a clear, specific definition of what the contractor is to accomplish with regard to the preparation for production cannot be over emphasized. In addition to providing the means of communicating production task to the prospective contractors, a definitive statement of work provides the structure upon which to evaluate proposals and, eventually, for monitoring and managing necessary preparation for production and, finally, the production effort itself.

b. Incentives. The production requirements of a program should be considered for incorporation into the incentive structure of the contract. Achievement of producibility goals, preparation for production goals, and delivery schedule improvement and/or capital investment are viable considerations. Production-related elements to be incorporated in the contractual incentive structure should be identified and discussed in this part of the plan.

c. Consistency Within and Among Contracts. Structuring the strategy and implementing contractual provisions for accomplishing the preparations for production, and the production effort itself, must be consistent. The plan for production should assess overall consistency of production provisions with the rest of the contract, and with other contracts required for overall program implementation.

7. Government Support to Contractor. The plan for productic.: should place special emphasis on the accomplishment of elements of direct support to the contractor to be furnished by the government. In addition, how it is to be acquired and managed must be addressed. Specific details that should be covered include requirements lead times as appropriate, special considerations, transportation and packaging requirements, and schedule for providing funding and planning information as necessary.

a. Government-Furnished Equipment/Material. Should the government elect to supply either or both GFE and GFM, the risk entailed in this decision should be carefully assessed as to impact on cost and schedule. Failure to deliver on time or failure of the delivered item because of design/quality problems, may be cause for the recipient to impose higher costs and/or schedule slippages. Agreed-to-in-advance work-arounds should be contractually negotiated to minimize GFE/GFM risks.

b. Exemplary Facilities Survey/Award. Such an award given by the government to a contractor after a careful survey of the contractor's entire program (including plant facilities, management style, adherence to the principles of TQM, etc.) could pave the way to streamlining the process by which business is conducted, particularly manufacturing and production.

8. Production Management Scheme. The production management structure within the government and the contractor(s) should be fully agreed to by all participants prior to LRIP/FRP. Management style such as TQM, reporting levels, process controls (such as SPC), etc., must be resolved prior to Milestones IIIA/III.

a. Program Staffing. Consideration must be given to how the service's first-line, production management team is to organized, what skills and technical expertise are to be, and what is to be provided via the selected organization. In addition to this overall approach to providing production management, the specific skills, numbers of people, and areas of responsibility, along with the phasing of production resources through the life of the program, should be identified.

b. Plant Representative Office (PRO). The government PRO is an excellent source of on-site information and management assistance. The PRO can provide continuous review of the contractor's preparation, tooling, process qualification/try out, staffing, etc. The Defense Contract Administration Service has provisions for providing intensive management support to particularly high visibility programs. Special or tailored management assistance from the PRO should be considered as appropriate. Any support from the PRO should be formalized by a written delegation or support agreement.

c. Department of Defense Research and Development Laboratories. The network of government laboratories is readily available to provide technical assistance and support in a wide range of material, process, and commodity areas. Planning should identify processes, materials, and other areas where laboratory assistance may be appropriate. Areas identified in the production risk assessment effort as having higher than normal risk are natural candidates for referral to the laboratories for assistance. As the situation warrants, consideration should be given to bringing the laboratories in on problem areas from the beginning, rather than after a crisis situation.

d. Consultant Support. The plan for production should address areas that need to be supplemented by consultant support, both government furnished and private agency generated.

e. Other Government Team Participation. Once the first line-production management team has been determined, consideration should be given to rounding out the management team with required specialist not normally available as "first line" members. A well-rounded team is essential to ensuring that a smooth transition from development to production takes place.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC Technical Management Department

Number: 7.2
Version: Update
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I. TITLE

Quality Assurance

II. REFERENCES

—DODD 4155.1, "Quality Program"

—DOD 4120.21, "Specifications and Standards Application"

—Federal Acquisition Regulations, Part 46

—MILSPEC-Q-9858A, "Quality Program Requirements"

—MILSPEC-I-45208, "Inspection System Requirements"

III. POINTS OF CONTACT

Office of Naval Acquisition Support (ONAS-06)
(202) 692-9058; AV 222-9058

Headquarters, U.S. Army Materiel Command (AMC-PP)
(202) 274-8429; AV 284-8429

Headquarters, Air Force Systems Command
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Product Assurance and Acquisition Logistics
(202) 981-5267; AV 284-5267

IV. PURPOSE AND SCOPE

This fact sheet is designed to:

—Describe quality assurance objectives in an acquisition program

—Identify program manager responsibilities

—Describe basic contractual provisions for quality assurance

—This document (Fact Sheet 7.2) has been prepared to acquaint program managers with some existing requirements and specifications associated with acquisition of quality products and services. It is not intended to conflict with or supplant Fact Sheet 1.13, "Total Quality Management (TQM)"

—Total Quality Management is a far-reaching, long-term concept for continuous improvement of all DOD products and services. The objective spans the breadth of DOD activities. "Product" means not only the weapons and systems fielded by military personnel but the result of all acquisition and logistics functions, including design, procurement, maintenance, supply, and support activities. Everything DOD does, every action taken, every system existing involves processes and products that can be improved or services that can be performed more efficiently.

—Total Quality Management is the application of management methods and human resources to control all processes with the objective of achieving continuous improvements in quality. The goal of TQM is to improve the quality of DOD products and services while achieving substantial reductions in the cost of ownership throughout the life cycle of our weapon systems. The objective of TQM is to broaden the concept of quality, focusing on quality much earlier in the system acquisition process, starting with requirements definition.

V. DOD POLICY.

It is DOD policy that:

—Contractors shall be held responsible for the quality of their products and services by means of:

—Contract provisions that place responsibility on contractors

—Exercising the right to reject or return contractor responsible defective items for repair or replacement

—Warranty clauses, when appropriate.

—The DOD components shall be considered in the use of:

—Contractual means for encouraging excellence in the conduct of contractor-responsible quality efforts

—Incentive free arrangements for achieving quality goals

—Reduced government surveillance when contractor quality performance so indicates

—Other non-contractual motivation techniques.

—Contractors shall be provided with maximum flexibility in establishing efficient and effective quality programs within specified contractual requirements.

—Contractors shall be held responsible for the quality of products and services furnished by their suppliers and government inspection at supplier facilities shall be held to an absolute minimum.

—The DOD components shall provide for inspection at destination whenever practical/required to ensure only quality products are accepted.

VI. DEFINITIONS

—Quality. The composite of materiel attributes including performance; features and characteristics of a product to satisfy a given need.

—Quality Program. Program which is planned, programmed and managed to carry out cost effectively, all efforts to effect the quality of materials and services from concept through validation, full-scale development, production, deployment and disposal.

—Quality Assurance. A planned and systematic pattern of all actions necessary to provide adequate confidence that adequate technical requirements are established; products and services conform to established technical requirements; and satisfactory performance is achieved.

—Quality Audit. A systematic examination of the acts and decisions with respect to quality in order to independently verify or evaluate the operational requirements of the quality program or the specification or contract requirements of the product or service.

—Metrology. The science of weights and measures used to determine conformance to technical requirements including the development of standards and systems for absolute and relative measurements.

Calibration. The comparison of a measurement system or device of unverified accuracy to a measurement system of known or greater accuracy to detect and correct any variation from required performance specifications of the unverified measurement system or device.

—Assessment Report. The report generated by an independent assessment of a major system during any phase of the acquisition and support process to provide an examination or evaluation of technical requirements, status toward achievement of those requirements, identify problems and problem causes and make recommendations for corrections of the problems or whatever needs to be done to improve either the requirements or the actions to achieve the requirements.

—Products. All items, materiel, material, data, software, supplies, systems, assemblies, subassemblies, or portions thereof which are produced, purchased, developed or otherwise used by DOD.

—Advisory Committee (AC/250) Group. National Directors for Quality Assurance responsible for formulating and promulgating NATO QA policy and procedures; includes subgroups, working groups, committees and panels under the authority of the AC/250 Group.

VII. QUALITY ASSURANCE

The DOD requires that the program management office develop and manage quality programs to achieve five specific objectives:

—Assure mission and operational effectiveness and user satisfaction with DOD products

—Assure that all services and products in which the DOD has an interest conform to specified requirements

—Assure that essential quality and related technical requirements are the minimum consistant with the above

—Tailor contractual quality requirements for each acquisition in compliance with DOD direction for specifications and standards application

—Assure that all of the above are cost effective.

Current DOD philosophy and procedures recognize that quality is not something that naturally results from the development or improvement of systems and equipment, but instead is the result of focused effort and attention during program planning, design, and manufacture. To achieve quality objectives in deployed systems, DOD Directive 4155.1 charges the program manager with the responsibility for the development and execution of a program to assure the quality of systems being acquired for use. More specifically, the Directive defines quality assurance as a planned and systematic pattern of all actions necessary to provide adequate confidence that adequate technical requirements are established, products and services conform to established technical requirements, and satisfactory performance is achieved.

The quality of DOD materials and equipment is the responsibility of every person involved in the acquisition or management of DOD materiel. The issue of product quality must be a central issue from the program initiation through the production and deployment phase of the life cycle. Within DOD, the "Quality Concept" consists of quality of design, prevention of defects, and quality of conformance. The quality of design effort begins with the program initiation phase of the material life cycle and continues through full-scale engineering development and many times continues into production and even redesign after deployment. Often mistakes in design are revealed due to production problems encountered when mass production is attempted or when customer complaints are received which report problems relating to quality of design. Defect prevention starts with the first development planning and continues through the operation and deployment phase of the life cycle. Quality of performance is normally associated with development production or initial production efforts and continues throughout production. Any time a problem in quality of design or quality of conformance becomes evident, the required corrective action must be taken to correct or fix the problem and its causes as long as the item or system remains in the DOD inventory. The DOD Directive 4155.1, "Quality Program," 10 August 1978, provides broad and general policy for the implementation of quality programs throughout DOD.

VIII. ORGANIZATIONS EXERCISING QUALITY CONTROL FUNCTION

There are three independent organizations involved in quality assurance functions for a given contract: the contractor, the government contract administration services (CAS), and the program manager's office (PMO). The contractor is responsible for assuring total contract conformance (product design, inspection, quality program, and product fabrication). The contractor's responsibilities reflected in section 46.105 of the Federal Acquisition Regulation (FAR) require that the contractor:

—Control quality (products and services)

—Offer to the government for inspection or acceptance only products and services which conform to contract requirements

—Maintain and furnish, when required, sustaining evidence of such conformance (records of quality control and inspection records).

The CAS organization is responsible for performing Government Procurement Quality Assurance (GPQA) which encompasses evaluating and determining the acceptability of the contractor's inspection system or quality program; assuring compliance with all contract requirements; evaluating the contractor's objective evidence of product conformance (inspection and quality assurance records); and performing verification of product conformance prior to acceptance.

The program office is responsible for assuring that user requirements have been translated into enforceable design-to or build-to requirements, participation in design and production readiness reviews and evaluation of contractor performance in meeting the required product assurance requirements.

IX. CONTRACT PROVISIONS FOR QUALITY

There are five basic levels of contractual provisions for quality:

—None—as on some commercial items contracts and small purchases

—Contractor responsibility provisions

—Standard Inspection Requirement (SF 32)

—MIL-I-45208A, Inspection System Requirement

—MIL-Q-9858A, Quality Program Requirement.

These contract quality requirements are explained as follows:

—When no quality requirement is imposed by contract, there is no specific obligation on the contractor for the performance of inspection and the government does not perform government procurement quality assurance actions at source; but, instead, relies on the contractor's normal internal controls to produce acceptable products.

—The Contractor Responsibility Provision (FAR 46.301) makes the contractor responsible for all inspections and tests necessary to assure conformance to all contract provisions. it reserves the right to the government to perform any or all inspections and tests before acceptance.

—Standard Inspection Requirement (FAR 46.202-2) is a mandatory for application of all fixed-price contracts for supplies in excess of $10,000. This should be omitted for commercial items. Its provisions alone are sufficient when buying items with quality characteristics for which measurement and inspection of the finished product will suffice to determine conformance to contract requirements.

—A contract Inspection System Requirement (in accordance with MIL-I-45208A) in addition to the Standard Inspection Requirement, is a requirement that the contractor establish and maintain an inspection system. This requirement shall be referenced in contracts with technical requirements such as to require control of quality by in-process as well as final end item inspection, including control of such elements as vendor supplied items, measuring and testing equipment drawings and changes, inspection, documentation, and records. The primary objectives and essential elements of an inspection system are prescribed in MIL-I-45208A. When this requirement is imposed, the Standard Inspection Requirement must also be included in the contract.

—Quality Program Requirement (MIL-Q-9858A) is a requirement, also in addition to the Standard Inspection Requirement, that the contractor establish and maintain a quality program acceptable to the government in accordance with a military specification. The requirement shall be established when the technical requirements to the contract are such as to require control of work operations, in-process controls and inspection, as well as attention to other factors (e.g., organization, planning, work instructions, documentation, control advanced metrology). The primary objectives and essential elements of a quality program are prescribed in MIL-Q-9858-A which shall be referenced in contracts when a quality program requirement has been established. When this requirement is imposed, the Standard Inspection Requirement must also be included in the contract.

(Note: both MIL-I-45208A and MIL-Q-9858A require the contractor to develop written procedures and make them available for review by the government to determine their acceptability before beginning production under the contract).

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

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I. TITLE

Industrial Modernization Incentives Program (IMIP)

II. REFERENCES

—DOD FAR Supplement, Section 215

—DOD Directive 5000.44, "Industrial Modernization Incentives Program," 16 April 1986

—DOD Guide 5000.44-G, "Industrial Modernization Incentives Program (IMIP)," August 1986

III. POINTS OF CONTACT

OSD:
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IV. PURPOSE AND SCOPE

This fact sheet is designed to:
—Define and explain the purpose of IMIP
—Explain the types of investment eligible for IMIP
—Explain the way of contracting and funding for productivity improvements under IMIP
—Explain the process of analysis to determine appropriate investments
—Explain the verification and tracking to determine actual savings
—Describe the current trends.

V. DEPARTMENT OF DEFENSE POLICY

It is the policy of the Department of Defense to provide industrial modernization incentives, as described in the DOD FAR Supplement 215.872, encouraging contractors, subcontractors and vendors to enhance productivity, reduce acquisition and other life-cycle costs and improve quality and reliability as a function of the manufacturing process. The DOD will encourage contractors to invest and improve processes, methods, techniques,

facilities, equipment software, and organizations, including the improved utilization of human resources, in order to obtain the most efficient and economical production of quality defense materials. It is the DOD policy to share with industry the savings resulting from the contractor's productivity enhancing investments and other cost-reducing improvements.

VI. THE INDUSTRIAL MODERNIZATION INCENTIVES PROGRAM (IMIP) CONCEPT

The subject of industrial productivity has become a topic of increased concern during the last decade as the United States has been outpaced by its Free World trading partners in the rate of change in increasing productivity. In the defense sector, the achievement of increased manufacturing efficiencies by defense contractors has become an area of major concern to DOD. Improvements in productivity are a critical element in reducing weapons systems acquisition cost.

A portion of defense manufacturing is done in an environment that can be characterized as utilizing outdated and inefficient capital equipment, and the process for most of defense manufacturing is a labor-intensive one. The problems most frequently cited in the defense industrial base as cause for reducing the rate of modernization and for slowing progress in the productivity area are DOD program uncertainties and a DOD cost-based profit policy. The program uncertainties such as changing levels of program funding and possible termination hinder investment amortization and inhibit long-term planning. A cost-based profit policy means that an important determinant of profit for defense contractors is the level of cost expected on the program. Under this policy a contractor may actually see profit reduced as a result of efforts to improve productivity and reduce costs. The profit policies may permit recovery of a portion of the early cost reduction but reduce longer-term profit potential on future contracts.

From the industry side, a factor working against productivity improving capital investment is the management emphasis on short-term profits, particularly as measured by return on investment (ROI). This philosophy can lead to extremely conservative capital asset management and long-term productivity gains can be lost in the desire to maximize profits for the current year.

The industrial modernization incentives program is designed to help focus contractor resources on industrial modernization. It helps support the development of more cost-efficient production capability for weapons systems, equipment and material. The IMIP encompasses and expands on previous service programs like the Air Force Technology Modernization Program and the Navy Industrial Productivity Incentives Program.

Under IMIP, incentives are provided to motivate a contractor to invest its own funds in improvements, which result in reducing acquisition costs. The DOD is willing to do things differently when it makes sound business sense. The idea is to negotiate a business arrangement that benefits both parties and represents a "win-win" situation. The major incentives under IMIP are shared savings rewards and contractor investment protection. The shared-savings rewards provide additional financial incentives and permit industry to share in the savings that result from productivity enhancing investments and related endeavors. The contractor investment protection involves the government assuming investment risk by agreeing to buy any undepreciated portion of a capital asset if the program is terminated. Investment protection may be used in appropriate circumstances such as a single-product line modernization where risks of change or termination are high. In some instances, IMIP can apply contractor investment protection to guarantee a long-term business base against which investment cost can be recovered. The contingent liability created by the contractor investment protection does not require funding but does require special approvals through the head of the contracting activity. Approval all the way through the Service, OSD, and the Congress are required for contingent liabilities greater than $10 million. These incentives of shared savings and investment protection may be used separately or in combination. Other incentives, such as award fees and government funding of selected planning, are permissable.

The IMIP program is not just to provide incentives for contractor investment in capital assets, but a wide range of productivity improvement projects. To make this point, the following defines the two types of investment eligible for IMIP. The first is the modernization investment project (MIP) that covers the traditional contractor investment in

capital assets, which are over and above normal capital expenditures. The second is the modernization efficiency project (MEP) that covers contractor productivity projects not requiring significant capital investment. These MEP projects provide significant improvements in productivity and lower contractor cost through improved work flow, management information systems, organizations, or many others. The significant element in an MEP project, just as with an MIP project, is the contractor demonstrating a significant cost reduction to DOD.

VII. CONTRACTING AND FUNDING

For maximum effectiveness, IMIP should be considered early in the acquisition cycle as part of the acquisition strategy. Normally, this consideration should be part of the industrial resource analysis required to support milestones I and II for major weapon systems acquisition. It is possible, however, to start an IMIP program well into the production phase if sufficient production is left after the implementation of a potentially lengthy capital investment program to make the savings worthwhile for the contractor and the government.

After preliminary discussions between the government and the contractor conclude, there are benefits to be gained by both, IMIP normally will be accomplished in three phases. Phase I is a structured analysis of the total manufacturing system. The scope should include an analysis of the existing manufacturing system to identify the interaction of the functional activities. Once the existing systems are understood, a conceptual design of the most cost-efficient factory is developed, along with projected cost savings or other tangible benefits that can be expected on weapon systems, equipment, or material after implementation. All the necessary steps to achieve the desired changes in the factory should be addressed. This Phase I plan should establish priorities and schedules for all required projects. At the culmination of Phase I, a contract is negotiated that establishes ground rules for Phases II and III.

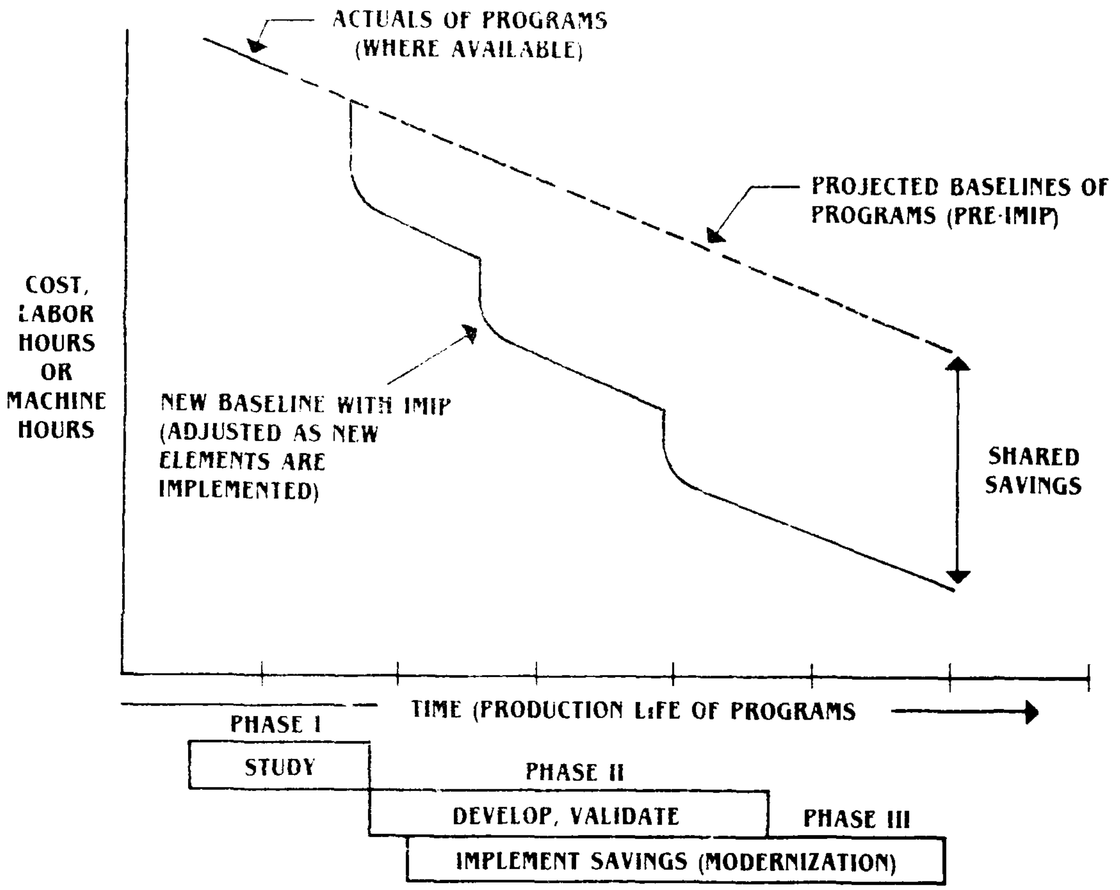
Phase II is the detailed design and validation phase and includes the development of the manufacturing technologies, the design of the factory for cost-effective modernization, and engineering/management applications of existing technologies for Phase III. Phase II plans for purchase and installation of capital equipment, specifies automatic data processing hardware and software operational requirements, and validates specific applications through modeling or method demonstrations. It may include prototyping enhancement of the manufacturing area. The objective of this phase is to identify and validate all the technology necessary to achieve the desired factory.

Phase III is the achievement of the optimized factory as identified in Phase I, and initiated and validated in Phase II. It includes the implementation of the manufacturing technology projects conducted earlier, and the purchase and installation of capital equipment identified in Phase II. The integration of improved factory subsystems takes place during this phase. The IMIP must be tailored to the particular situation. Where all the requirements of the earlier phases have been met, it may be possible to begin the program with the third phase. The IMIP concept and the normal sequence of activity are illustrated in Figure 1.

An IMIP business agreement usually is initiated in the form of an MOU between the DOD contracting agency and the contractor. This document is negotiated early in the IMIP cycle, generally before or in conjunction with the Phase I effort. It is used to ensure a meeting of the minds exists between the parties before the contractor initiates significant IMIP activities. The business agreement negotiation process is incremental, initially embodied in an MOU or a solicitation, and subsequently definitized by a contract action. Definitized terms and conditions may be included in an IMIP master contract and/or included in applicable system(s) contracts. An IMIP master contract is a single, centralized contract between the contractor and the designated government contracting officer and contains all terms and conditions necessary to implement it. It is particularly suited to a plant-wide IMIP covering all defense items produced in a facility. Where only an individual or a few major programs are impacted by IMIP activities, the contractual agreements may be included in the applicable system contracts.

The sharing of savings between the government and the contractor is the primary IMIP contract incentive. The portion of the IMIP savings/cost avoidances earned by the contractor is referred to

Figure 1. IMIP AND BASELINE ADJUSTMENTS TO PROGRAMS



as the productivity savings rewards (PSR). The IMIP government benefits are referred to as "savings" when current contract prices are reduced, and as "cost avoidances" when they apply to contracts yet to be priced. The ways of sharing savings between the contractor and the DOD are numerous and, for a particular contract, should be tailored to the specific situation. The savings can be shared only on current contracts, or, there can be some mixture of current and future contracts. Where all of the sharing is to be accomplished on a few major programs on current and future contracts, it is called "protected sharing" and is incorporated into the contracts on these programs only. When a number of DOD programs are benefiting from the investments for both current and future contracts, it may be better to have a facility-wide IMIP master contract that provides sharing through a sharing factor. This sharing factor is applied to all programs in the facility for a specific agreed-to period of time. The determination of the specific time period includes consideration of such factors as asset life, length of current contracts, and period of the anticipated economic benefits.

It is government policy that the contractor normally should conduct all IMIP efforts without government funding. However, when it is in the best interest of the government, funding may be provided by the government for selected portions of the study. The DODD 5000.44-G gives a detailed discussion concerning criteria for use of direct government funding. Direct government funding may be provided in Phases I and II from the individual acquisition programs involved, or from the appropriate categories of Program Element (PE) 78011, "Industrial Preparedness". To the extent practical, funding should be shared among the benefiting programs and DOD components. The

relative order of preference for the source of IMIP funding is (1) contractor investment, (2) weapon systems/equipment funding, and (3) PE 78011 funding. The investment of funds in capital equipment in Phase III is to be funded solely by the contractor. Manufacturing technology programs, while related, are separate entities with separate government funding.

VIII. IMIP ANALYSIS

Under the IMIP Concept, planning for productivity enhancements has three parts: factory analysis, strategic plan, and the investment plan. These are the three parts to be submitted as an IMIP proposal. These plans, in effect, become the IMIP performance baseline and are subject to refinement in any later phase. The IMIP structured approach, through these three plans, may have significant value for assessing the transition from development to production, in addition to its intended use in the development of a contractual incentive arrangement.

The objective of factory analysis is to provide a framework for planning productivity enhancement activities on the basis of a detailed understanding of the entire manufacturing operation. Manufacturing is a complex process with many related activities and functions. In the past, productivity enhancement was a matter of substituting a capital-intensive process, such as a manually operated machine tool. Now, it is recognized that the greatest gains in productivity can be achieved by linking manufacturing functions and activities in an analysis called "factory integration." Factory integration requires a look at the factory as a total system; however, scope and complexity of manufacturing make it difficult to view the manufacturing system as a whole. Because of this, there are methods of looking at a smaller, more comprehensible part of the manufacturing system, while retaining the context of this smaller part in the total system.

In contrast to the factory analysis, with its emphasis on the shop-floor technology, the strategic plan captures the company's top management vision for the factory. Considerations that are a part of this strategic plan include the market forecast, sales and profit growth objectives, capital investment levels, and hurdle rates. The factory analysis and strategic plan should be reconciled so that what is technically desirable fits with the company's strategic plan. This reconciliation will help ensure the implementation of technically successful projects.

The third part is the investment analysis using techniques appropriate for the evaluation of the quantifiable benefits and cost of the productivity enhancing investments. The financial investment analysis determines the financial effects of proposed investments on the contractor, the Department of Defense, and the government as a whole. The proposal from the contractor is considered financially attractive if cost savings from enhanced productivity are sufficient to fund the contractor's incentive, while still providing DOD significant price reductions.

To achieve the desired "win-win" situation, it is necessary that the contractor and the government understand and conduct a detailed investment analysis. To accomplish this, it is necessary to develop a baseline for comparison of the new projects. This is determined by costing the anticipated work based on the existing equipment without the proposed changes. This becomes the baseline against which the proposed changes are evaluated in form of delta or incremental cash flows to implement new projects.

The cash flows will be over a number of years so it is essential to recognize the time-value of money. This is accomplished by use of a discounted cash-flow technique that computes the present values for all anticipated delta cash flows. Net present value (NPV) is defined as the present value of the cash inflows minus the present value of the cash outflows. A positive NPV means the project has a return greater than the discount rate used. Another valuable calculation is the internal rate of return (IRR), the discount rate at which the net present value for a project is zero. The IRR measures the return of the investment project and presents it in a percentage form while considering the time value of money, making it a useful measure of the financial attractiveness of the project. The most difficult element of the discounted cash-flow analysis is the determination of all elements of the contractor's cash flow that are effected by the proposed investment.

A personal computer model has been developed for use by DOD representatives. Other models, tailored to the individual acquisition situation, may be used at the discretion of the IMIP contracting officer and subject to approval by higher authority. Check your Service point-of-contact for further information.

IX. IMIP VERIFICATION AND TRACKING

It is necessary to focus on validation and verification requirements early in the IMIP process, and to formulate a viable cost-savings measurement system that makes sense to all parties. This system is dependent on the types of incentives used and may, of necessity, be rigorous when the incentive contemplated is shared savings. The concept of shared savings is predicated on the ability to accurately track actual cost under the new manufacturing system as compared with the base-line cost under the current existing system. Cost savings are the basic justification for any manufacturing cost-reduction program, and a sound system for measuring cost savings must be developed by the contractor and approved by the government as a basis for shared savings. Having recognized the need and importance of an effective cost-savings measurement system, a balance must be achieved not to overburden the process with elaborate audit and verification systems, which may not be cost effective.

The cost-savings measurement system should be integrated with the overall factory planning system. This will allow for greater flexibility in using the system and will ensure that all data within the factory planning system will be available for cost-savings analysis. It should allow management to obtain real-time feedback for making adjustments and measuring progress of an IMIP. The system can have a synergistic effect on the success of IMIP projects.

The cost-savings measurement system must access direct-to-indirect cost relationships. Traditional allocation of indirect cost should be reviewed when establishing a cost-savings measurement system. In redesign of factory systems, indirect cost-variation patterns may be shifted from lower percentages of direct labor to higher percentages of "value added" cost. In this situation, different sets of allocation basis may have a more "causal-beneficial" relationship to indirect expenses. The appropriate time to consider accounting changes is *before*, not *after*, IMIP implementation.

Government representatives should participate in all stages of the cost-savings measuring system development. The system should be designed to achieve a reasonable degree of precision, realizing that exact cost savings are not usually attainable at a reasonable cost. To aid in this selection of a degree of precision, the significant cost drivers should be determined on the basis of a top-down functional review of the manufacturing method or process. In some cases, the tracking system will be needed, at subfunctional levels below where traditional tracking systems have been required to enable measurement of savings and discrete units of input to the product. Here, good judgment is required to prevent a burdensome verification system.

There can be major problems in developing and implementing a cost-savings measurement system, and an accurate cost baseline is a prerequisite for success. This may be difficult to determine and validate if no historical data are available. It should be recognized that the magnitude of obtainable data for manufacturing methods may be so large, and require such extensive record keeping, that a form of sampling will be required.

The cost and benefits of the system should be reviewed at least three times. First, in the economic analysis stage as part of the factory analysis where the estimates would be "rough order of magnitude" numbers. The second review takes place before negotiation of a business arrangement, and its results are incorporated in the MOU after a business arrangement is negotiated. A final review should be conducted as a post-implementation assessment, which is generally 12 months after IMIP implementation.

X. CURRENT TRENDS

The IMIP test has been regarded generally as successful. The program has already saved approximately $630 million on existing contracts and has generated $1.7 billion in contracting investment. Estimated savings through the 1990s are approximately $7 billion. The following are three trends in implementation.

—While the IMIP forerunner programs were largely single, major programs with program funding and incorporation into the program contract, the current trend appears to be toward facility-wide agreements. This will involve using a sharing factor and having a single IMIP master contract for the facility. This opens the use of IMIP to a wide range of facilities that are not dominated by a single program.

—Secondly, there is a trend toward less government funding up-front, with a preference to no government funding. This means a greater sharing of the savings by the government with the contractor. This striking of the appropriate balance between funding and shared savings in the IMIP program is an important aspect of obtaining a "win-win" result.

—A final trend is the increasing involvement by subcontractors and vendors through either a flow-down arrangement from the prime contractors, or by an industry-wide involvement by the government with a critical industry like the manufacturers of traveling wave tubes. Involvement by subcontractors and vendors significantly increases the facilities that can be involved with IMIP and addressed a portion of the defense industry base, which is considered the least modernized and most labor intensive.

INSERT TAB 8

INTERNATIONAL ACTIVITIES, JOINT PROGRAM AND FMS

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Authors: DSMC, Executive and International Department
Number: 8.1
Version: Update
Date: January 1989

I. TITLE

The Security Assistance Program: Foreign Military Sales (FMS)

II. REFERENCES

—DOD Manual 5105.38M: Security Assistance Management Manual

—DOD Manual 7290.3-M: Foreign Military Sales Financial Management Manual

—USAF AFR 130.1 Security Assistance Management

—USA AR 12-8 Foreign Military Sales Operations/Procedures

—USN NAVMATINST 4900.22, The Naval Materiel Command Security Assistance Program and Support Planning Manual

—USN Naval Supply Systems Command Publication 526 Foreign Military Sales Customer Supply System Guide

III. POINTS OF CONTACT

Under Secretary of State for Security Assistance, Science, and Technology
(202) 692-5831

Under Secretary of Defense for Policy
AV 227-7200

Defense Institute for Security Assistance Management (DISAM)
AV 785-5850

Defense Security Assistance Agency
AV 225-3291

IV. PURPOSE AND SCOPE

To provide a simplified description of the Security Assistance Program, primarily FMS.

V. INTRODUCTION

An important instrument of U.S. foreign policy is the provision of defense articles, defense services, and military training to U.S. allies and friendly foreign nations. Such transfers occur through a variety of means, including cash sales, grant, credit, lease, and loan programs. These programs are cumulatively termed the United States Security Assistance Program.

A major component of security assistance is the Foreign Military Sales (FMS) program. This involves government to government sales of U.S. defense items, as authorized under the Foreign Assistance Act of 1961 and the Arms Export Control Act. Recipient governments generally pay cash for the full costs associated with such sales; however, programs of U.S. appropriated grants and repayable loans are available to selected recipients to permit their purchase of these defense items.

VI. PARTICIPANTS

Background

The FMS is an instrument of foreign policy. Therefore, the Congress and several departments within the Executive Branch are involved in its implementation. On occasion, the Judicial Branch is involved. A brief look at the roles of the Executive Branch, the Congress, and other departments in the process of military sales to foreign governments, are as follows:

The Congress

The Congress exercises increasing scrutiny and regulation of the process. Frequently, the Executive and Legislative Branches differ in their viewpoints about the use of FMS to further U.S. foreign policy.

Significant transfers of military equipment began during WWII with authority provided by the Lend Lease Act of 1941. Assistance has continued during the years by virtue of laws such as:

—Economic Cooperation Act of 1948 (Marshall Plan)

—Foreign Assistance Acts of 1961-1967

—Foreign Military Sales Act of 1968 and Amendments.

After WWII and well into the 1950s, U.S. assistance was grant oriented. Around 1957, spurred by U.S. balance of payments problems and the continuing economic recovery of nations aided after WWII, the United States changed its pricing policy from cost of replacement to actual cash value. This trend continued with direction by the Congress in 1962 to phase out grant-aid in favor of military sales. However, in the early 1980s, the continuing problems of international debt faced by many recipient countries in the Third World led to an increase in so-called "forgiven loans" (i.e., FMS grants) and a resurrection of the all-grant Military Assistance Program (MAP) for use in acquiring defense items through the FMS program.

Executive Office of the President

The U.S. Constitution infers that the President is chief arbiter in matters of foreign policy. The President submits the security assistance program budget to the Congress and executes the program once it becomes law. The organizations within the Executive Office of the President that have an impact on security assistance are as follows:

—*National Security Council.* The President chairs the council. Its function is to advise the President with respect to integration of domestic, foreign and military policies relating to national security. Hence its involvement in security assistance.

—*Office of Management and Budget.* Assists in preparing the President's budget, which includes security assistance, and is interested in the relationship between DOD and security assistance funding.

State Department

By law, the Secretary of State is responsible for the "continuous supervision and general direction" of the security assistance program. The Secretary determines if there will be a security assistance program, sale or export for a country, as well as its value. The Secretary ensures that these programs are integrated at home and abroad and that they serve U.S. foreign policy.

Strengthening the relationship between FMS and U.S. foreign policy began in 1954 when the State Department, under authority of the Mutual Security Act, 1954, began to control export licenses for "arms, ammunition and implements of war." The Office of Munitions Control within the Politico-Military Bureau (PM-MC) is now responsible for administering the International Traffic in Arms Regulations (ITAR) and the U.S. Munitions List (USML), which provides rules for the registration of and import and export licensing for all direct commercial imports and exports of armaments into and out of the United States. The Under Secretary of State for Security Assistance, Science, and Technology is the principal adviser and focal point for security assistance matters within the Department, and is chairman of the Arms Transfer Management Group, an inter-agency board that makes recommendations to the Secretary of State about security assistance and arms transfer matters.

Department of Treasury

As financial agent for the U.S. Government, the Treasury Department is involved in security assistance while monitoring the cash flow of its foreign military sales trust fund account. It also is involved in:

—The guaranteed credit program

—Arms *import* control

—Export clearance through the U.S. customs service.

Department of Commerce

Commerce interfaces with the Departments of State and Defense with respect to civil items having possible military application and where there are technology transfer implications. The Department's Maritime Administration ensures that U.S. flag shipping is used for U.S. funded programs.

Department of Defense

The Defense Department has the greatest involvement in security assistance of any department within the Executive Branch. The Secretary of Defense has primary responsibility for the following security assistance functions:

—Relative to military equipments
 —Determination of requirements
 —Procurement
 —Supervision of use by recipient countries
 —Movement and delivery
 —Establishment of priorities
 —Other functions related to sales and loan guaranties.

—Supervision of training for foreign military and related civilian personnel

The Under Secretary of Defense for Policy is the principal adviser to the Secretary for all matters concerned with national security objectives. Under his supervision, direct and overall DOD management responsibility for security assistance rests with the Director, Defense Security Assistance Agency. Within the Department of Defense, the remaining key players and organizations are:

—Assistant Secretaries of Defense
 —International Security Affairs
 —International Security Policy
 —Acquisition and Logistics
 —Comptroller.

—Under Secretary of Defense for Acquisition
—Joint Chiefs of Staff, unified commands and overseas activities
—Various defense agencies
—The military departments.

VII. FMS PROCESS

Background

The process by which foreign military sales occur is structured. Typically, it begins because representatives of another country (e.g., administration, military planners) have seen a weapons system, and/or followed its development, and see it as meeting their needs. The ensuing process will follow the steps listed below until the sale is closed.

Letter of Request

A Letter of Request is the means by which a country indicates an interest in military equipment or other articles listed on the U.S. Munitions List. Submission channels and types of request vary. The country may request general information on the equipment (i.e., planning and review date) or more detailed and specific information (i.e., price and availability data).

The U.S. Military Department that has received the request will acknowledge receipt of the LOR and validate eligibility of the potential recipient.

During this period, the country interested in purchasing equipment will be confirming its requirement, possible funding, and its ability to manage a system acquisition. They may request visits with U.S. Government officials or meet directly with company representatives. Any data on cost, schedule, or intent to enter into an agreement must be provided with the clear understanding that no commitment is involved. The customer will use the information to decide to buy through FMS or directly from the manufacturer. Once the purchasing country decides that the sale should be on a government-to-government basis, that country formally requests a letter of offer and acceptance (LOA-DD Form 1513).

Letter of Offer and Acceptance (LOA)

The military department responsible for the case will prepare the DD Form 1513. The LOA is key to the FMS process; great care is required in its preparation and careful review in the approval process. It specifies terms and conditions both governments will abide by. It typically must include:

—Cost, schedule, and configuration
—Logistic factors such as
 —Follow-on support
 —Facilities
 —Training
 —Publications
 —Maintenance
 —Spare parts

One important point to be stressed in writing, and throughout the FMS process, is that price and availability information are only estimates.

The completed LOA must be reviewed and approved within DOD, by the Department of State and any other involved agencies. If the proposal exceeds a specified dollar threshold it must be submitted to the Congress for approval. If the Congress fails to object to the sale by joint resolution within 30 calendar days, DD Form 1513 is forwarded to the requesting country.

Implementation of Sale

If the offer is acceptable, the purchaser must complete and sign the form and return it with the initial deposit. The DD Form 1513 now constitutes a formal agreement between the United States and the purchasing country. Upon receipt of the form, the DOD component prepares documentation directing implementation.

The actual procurement and supply actions for the FMS program are carried out by U.S. procurement and logistics agencies in the same manner as for U.S. programs. The FMS case is closed when all items and services listed in the LOA have been shipped, billed, and paid for.

Follow-On Support

When support is part of the FMS agreement, it is furnished through existing DOD logistics infrastructure. The same supply, transportation, and maintenance system used for support of U.S. forces is used for FMS. It is U.S. policy that the FMS purchaser be responsible for as much of the transportation process as possible. The primary interface between the foreign country and the U.S. logistics system is the international logistics control office for the involved service. These offices have dedicated contact points for logistics problem resolution.

FMS Finance

—*Funds Management.* For a case to be implemented, obligational authority must be passed from the security assistance accounting center to the DOD component. This allows items to be released from DOD inventories and for contracts to be awarded on the purchaser's behalf. Eventually, expenditure authority must be received in order to pay contractor invoices.

— *Billing.* The Arms Export Control Act (AECA) provides the legal basis for FMS billing policies and procedures. The act requires that all FMS activities be conducted at no cost to the U.S. Government, that all costs be collected from the recipient government, and that payments be made in advance of delivery. Implementing agencies report the cost of DOD services, inventory, and new procurement sales to the security assistance accounting center. Based on these reports, the center computes and bills FMS customers for accrued expenditures and costs resulting from the application of various surcharges.

—*Payment.* Each DD Form 1513 must reflect easily understood payment terminology. This is done through the use of terms of sale and the financial annex. Payment in all cases must be in U.S. dollars. The customer normally must make cash payment prior to item delivery; in special situations, generally under emergency conditions, payment may be authorized to be made upon delivery or up to 120 days after delivery. Payment sources for FMS purchases include the following:

—Recipient government cash resources.

—Private financing obtained by the recipient government, and treated by the U.S.G. as recipient government cash resources.

—FMS Financing Program funds which involve monies furnished directly to selected recipient countries by the U.S.G. from appropriations provided annually by the Congress. Such funds may be in the form of PMS grants (formerly termed "forgiven loans") or FMS repayable loans. The repayable loan funds are furnished at annual concessional rates of interest (i.e., below the annual cost of money to the U.S.G., but no lower than five percent per annum), with full repayment required within 12 years.

—Military Assistance Program (MAP) grant funds furnished directly to selected recipient countries by the U.S.G. from appropriations provided annually by the Congress. Prior to FY 1982, MAP was used to furnish excess/surplus military equipment directly to U.S. allies and friendly foreign countries. Equipment valued at over $54 billion was so transferred in the period 1950-81. Since FY 1982, appropriated MAP funds have been merged with other FMS funds available to a purchasing country to pay for FMS acquisitions.

VIII. SUMMARY

FMS is one of the instruments our foreign policy customers prefer because:

It gives them access to equipment and technology otherwise unavailable.

It provides them with equipment and training, normally at favorable cost.

It provides reasonable guarantees of life-of-item support.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Policy and Organization Management Department
Number: 8.2
Version: Update
Date: December 1988

I. TITLE

Joint and Multiservice Programs

II. REFERENCES

—*Joint Logistics Commanders Guide for the Management of Joint Service Programs*, Defense Systems Management College, Fort Belvoir, VA, Third Edition, 1987, especially Appendix C, "Memorandum of Agreement on Multiservice Operational Test and Evaluation and Joint Test and Evaluation"

—*The 31 Initiatives: A Study in Air Force-Army Cooperation*, R.G. Davis, Office of Air Force History, 1987, especially the appendices

—DOD Directive 5000.3

—AFLC/ASFC R 800-2/AMCR 70-59/NAVMATINST 5000.10 A, "Management of Multi-Service Systems/Projects/Programs"

III. POINTS OF CONTACT

Pre-Milestone I programs, call the Interoperability, Integration and Initiatives Division, J-7 (Joint Staff), (703) 694-4651; AV 224-4651

Milestone I and beyond, call the Systems Programs Evaluation Division, J-8, (703) 694-3681; AV 224-3681

Command, Control and Communications programs, call the Planning and Priorities Division, J-6, (703) 695-7168; AV 225-7168

IV. PURPOSE AND SCOPE

This fact sheet is designed to:

—Provide a description of joint programs
—Describe joint program initiation
—Describe the process of gaining approval of a joint PM charter
—Describe the contents of a joint PM charter
—Offer some program perspectives.

V. DOD POLICY

Joint programs are strongly supported and encouraged by the Office of the Secretary of Defense and the Congress. The reasons for advocating a joint program are many and varied but are ultimately reducible to some operational or economic advantage to DOD. Typically, one or more of the following factors is at work:

—Improving Combat Capability

—Coordination of Efforts. Coordination reduces duplication of effort, improves exchange of technical information, and channels individual Service efforts into mutually supportive programs.

—Interoperability of Forces and Equipment, especially in the areas of command, control and communications.

—Reduction in Development Costs. If the requirements of the combat components are compatible, and consolidation of programs does not increase risk unduly by closing out alternatives, it makes sense to fund one joint program, rather than multiple, single-Service efforts.

—Reduction in Production Costs. Consolidation of the Services' production requirements should lower unit price.

—Reduction in Logistics Requirements. Standardization across the Services offers potential for both reducing support costs and improving support provided to operating forces.

In 1973, the joint logistics commanders signed a memorandum of agreement that was subsequently promulgated as a joint regulation (a copy of the agreement is in Appendix A). That document sets forth principles of joint-program management that continue to provide a solid foundation to the establishment of a joint program management office. It introduces the concept of the executive (sometimes referred to as lead) and the participating Services, and establishes general responsibilities and authorities of both. It provides for use of executive service program management procedures in areas where common procedures do not exist and calls for multiservice program charters, program master plans, and joint operating procedures to be prepared as documentary instruments of joint program management.

Early every year, the Service R&D chiefs prepare and then review Joint Potential Designation Lists—the lists they use to keep tabs on programs with joint potential. These lists are sent to the Joint Requirements Oversight Council (JROC) every April for review. The JROC reviews all Acquisition Category I through IV programs (or their equivalents), coming up for Milestone 0, I and II reviews to assess the potential for joint Service development and/or production. THe JROC is composed of the Service Vice Chiefs and chaired by the Vice Chairman of the Joint Chiefs of Staff. Because the chairman of the JROC is also the vice chairman of the DAB, there is a direct link between the joint requirements review process and the milestone review process. This is beginning to have an impact on programs. In June 1988, for example, the JROC and Conventional Systems Committee of the DAB developed a "joint standoff weapons master plan" that reduced the number of air-to-surface standoff weapon programs from nine to five (and only two of the five will have extended production runs). This sort of executive action will increase if congressional pressure for joint programs grows.

The basic requirements document for a major acquisition program is the Mission Need Statement (MNS). A MNS identifies a specific military deficiency in a mission area, the priority assigned to correcting the deficiency, and the magnitude of resources needed to correct the deficiency. A joint MNS documents major deficiencies existing in two or more combat components. The DAB approval of an MNS is a prerequisite for initiation of a major system acquisition program. Operational requirements for less-than-major acquisitions continue to be stated in Service-peculiar requirements documents which tend to be more detailed and more weapon-system-oriented (vice mission-oriented) than an MNS. This same practice is likely to hold true for joint acquisitions: major acquisitions will be supported by a joint MNS; less-than-major acquisitions will be supported by a joint operational requirement (JOR), or similar document, which is more weapon-system-oriented than an MNS.

When a joint or OSD/Joint MNS is submitted, the Secretary of Defense (SECDEF) decision will be documented in a SECDEF Acquisition Decision Memorandum (ADM). The ADM may specify the lead DOD component and should provide explicit guidance on the responsibilities of the participating DOD components, including threat support. The lead DOD component will assign the program manager and may request the other participating DOD components to assign deputy program managers. The lead DOD component also will establish program objectives by promulgating a program charter after coordinating with the other participating DOD components.

VI. JOINT PROGRAM INITIATION

Few programs become joint without some initiative by the Joint Staff, the Congress or the Under Secretary of Defense for Acquisition.

Typically, the Under Secretary of Defense for Acquisition, with the assistance of the JROC, writes a memorandum designating one Service the executive or lead Service and directing it to charter a joint program. Less formal, but no less compelling, direction is given to the Services during program or budget reviews. The Vice Chairman of the Joint Chiefs of Staff is responsible for making sure that such reviews do not overlook the potential for joint development and that joint programs are not ignored in Service POMs.

The Services negotiate the ground rules of the joint program and agree to assignment of program authority and responsibility. The implementation of OSD direction is different in each of the Services. The Army and Navy simply forward by memorandum USD(A)'s direction to the appropriate develop-

ment and acquisition activity via the chain of command. In the Air Force, the Assistant Secretary for Acquisition directs major command participation, either as lead or supporting elements, via program management directives (PMD). Further delineation of participation below major command level is promulated by Form 56 within AFSC, and program action directive (PAD) within AFLC.

Interservice negotiation and agreement on a joint program can be accomplished at any of several echelons in the Services' organizational hierarchies: the Service secretariats, the Service headquarters, the material development and logistics commands, or their commodity-oriented commands. Examples include the 31 initiatives agreed to in 1984 by the Army and Air Force. These agreements covered issues of doctrine, Service roles and missions, and joint development. Eventually expanded to 38, all but five of these initiatives had been resolved as of 1988. Their development and resolution show the Services must often reach agreement on their respective mission needs and responsibilities before they can move ahead with joint development.

If there is a general rule, it is to agree that the lowest level agreement is practicable, and that level varies from program to program. However, there are two advantages to agreements at the Service headquarters level: (1) it is the level at which operational requirements are validated and translated into equipment needs; and (2) it is the level at which funding priorities are established. Assuming Service headquarters staffs agree, PMs must be alert for any disagreement between the headquarters and Service secretariat levels. As all joint program managers soon learn, *nothing is more important to the success of a joint program than interservice agreement on requirements and funding.*

When agreement is reached at the Service headquarters and secretariat level, it is usually documented by a memorandum of agreement (MOA). There is no typical content of format for an MOA. It may be a long document defining all the ground rules for the joint program, much as would a charter. It may be very brief, covering only key areas of agreement, such as designation of the executive service and sharing of funding responsibility. Frequently, a program will have several MOAs associated with it, each covering a different topic.

VII. JOINT PROGRAM CHARTER PREPARATION

The charter, once promulgated, is the foundation of a joint program. It establishes the program and announces to all concerned the responsibility and the intended relationships among the participating Services. When possible, the individual selected to be the PM should be reponsible for the drafting of the charter. When OSD directs the initiation of a joint program, they can include in the directive provisions for an interim charter and staffing of the PMO. If OSD elects not to do this the lead Service should ensure the PM has an interim charter to use until an agreed-upon charter is obtained. The final charter should give the PM sufficient authority to accomplish the given responsibilities. As a minimum the PM must have adequate authority to:

—Make trade-offs among cost, schedule, supportability and performance within the established bounds for the program. It is difficult for a user in one Service to give this totally to a PM in another Service, but it must be done to have a successful program. The important thing is to define the bounds, and control the PM's action through reviews instead of limiting his/her power.

—Identify program funding needs and control funds allocated to the program. When Services "donate" funds to a joint program, there is a reluctance to give up total control of the funds, although the JROC is pressing for this. Getting agreement on the funding issue in the development of charter requires creative staffing to get a document.

—Determine and control hardware and software configuration.

—Communicate directly with the other Services and government agencies.

—Manage his/her military and civilian work force.

A good joint program manager will realize that to be successful, support from the participating Service is required. He/she can begin getting that support while drafting the charter. This is the time for the PM to "hit the halls" and find out the concerns of the Services and start lobbying for his/her proposed charter. First impressions are important and the PM must establish trust early. The more

the Services trust a PM the more they will be willing to give up items in the charter.

Charters for joint programs are normally promulgated by the executive service. The JLC "Memorandum of Agreement on Management of Multi-Service Systems/Programs/Projects" calls for joint approval of joint program charters for major programs. However, such jointly signed charters are rare. Army charters are approved by the Secretary of the Army; Navy charters by the Navy Acquisition Executive; and the Air Force program management directives by the Assistant Secretary of the Air Force for Acquisition or the Deputy Chief of Staff (Logistics and Engineering). For non-major programs, the chartering is delegated to the materiel development or logistics commanders according to specific Service practices. On a few occasions, program charters have been promulgated directly by OSD, but that is unusual and has occurred primarily when OSD wanted to coordinate independent service programs in an active way. Even though there is no formal requirement to gain concurrence from the other Services, it is the best interest of the PM and the program to staff the charter with the partgicipating Services even if there has been an MOA signed.

If OSD retains approval authority, the lead Service is responsible for the submission of the charter. There are two ways the charter can be submitted:

—If OSD specifies the charter be submitted through the Joint Staff, the charter is submitted by the Service chief to the Joint Staff and a joint action is initiated to gain JCS recommendation for OSD. One thing to remember is that once the joint action is started *the responsibility for the action lies with the joint action officer and the lead Service reverts to being a voting player with the same status as the other Services*. Also, the Services that may not be a party to the program may be involved and will vote on the charter in the joint action.

—If there is no requirement for JCS recommendation, the charter will more than likely be submitted to OSD by the Service Secretary.

VIII. CONTENTS OF A JOINT PROGRAM CHARTER

Joint programs are exceptions to the Services normal acquisition practices. Thus, the joint program charter must include those elements essential to any charter and those needed to define specific relationships among the participating Services. The extent to which the latter must be defined in the charter depends on the circumstances surrounding establishment of the joint program. If, at the inauguration of a joing program, there exists a major issue involving responsibility, authority, or inter-Service relationships, it should be resolved in the charter, or *it will haunt the program throughout its life*. The following items are considered as essential items in the charter:

—*Designation of the Joint Program.*

—*Statement of the Program Objective.* It is extremely important that this section of the charter be well written and not open to interpretation. It is where the bounds are established.

—*Definition of the PM's Authority, Responsibility, and Accountability.* The accountability can be tricky because the participating Services will want some accountability by the PM to them. What must be avoided is having a joint PM answering to many people and organizations.

—*Specifications of Program Funding and Resources.* Again, this is probably the hardest item to get agreement on. The easiest thing is to have the lead Service fund the whole development project and let the participating Services fund for the procurement of their systems. It is the easiest way for the PM but difficult to get agreement on from the lead Service. If the funding is split among the participating Services, they will not agree unless they see it as a means of controlling the PM. The method that is best for a program will depend on the program and the environment when the charter is staffed.

—*Definition of the Services' Joint or Unilateral Responsibilities for Program Execution.*

—*Description of the Relationship of the Joint Program with Other Programs, Supporting Organizations, and Supported Organizations.*

—*Identification of the Chain of Command for Reporting and for Resolving Program Issues.* Every attempt should be made to keep the level for resolving issues as low as possible.

—*Reporting Requirements (Type, Format, and Frequency).* One thing often overlooked is a respon-

sibility for the PM to keep the participating Service and the user, especially joint users, informed of program status. Provisions for this type of reporting should be included in the charter.

—*Project Office Organization and Initial Staffing.*

—*Requirement to Establish Joint Operating Procedures.*

The following items are "officially" optional elements but in reality *should be considered as essential:*

—*Assignment of the Deputy PMs from the Participating Services, Definition of Their Responsibility and Authority, and Designation of Their Rating Officials.*

—*Methods of Resolving Conflicting Requirements or Objectives of the Services Involved.*

—*Creation of Joint Committees for Coordination or Approval of Key Aspects of the Program (i.e., requirements, funding, source selection, test and evaluation plans, and configuration).*

—*Performance Evaluation of Personnel.*

IX. A PROGRAM MANAGER'S PERSPECTIVE

At the outset of a joint program, the joint program manager should conduct a detailed technical requirements review that examines mission needs, operational concepts and environments, and performance parameters. He/she should ensure that requirements are understood, that conflicts are resolved, and that there is sufficient latitude to make the trade-offs essential to any program's success. This review should accomplish the following:

—Identify the similarities and differences in the Service's requirements and in the operation environments.

—Force a clear distinction between the "like to have" and "must have" requirements.

—Identify areas of technical risk or uncertainty.

—Identify the similarities and differences in the Services' logistic concepts, requirements, and procedures, including their approach to the implementation of the life-cycle cost concept.

Once the requirements of each Service are well understood, the joint program manager should define the set of essential requirements that is most demanding in terms of cost, schedule, and performance criteria. It will require determining the extent to which commonality of hardware and software, frequently an explicit or implied goal of a joint program, is a valid requirement and is achievable. Some joint programs will be considered successful only if they develop identical or nearly identical systems for use in all Services. The value of other joint programs however, may be only in sharing the costs of concept formulation and validation or in coordinating the engineering development of systems peculiar to each Service and ensuring their interoperability; trying to develop identical or nearly identical systems for all the Services may frustrate the program and lead to its failure.

The preparation for each milestone review should include a re-examination of the same items reviewed at the initiation of the joint program. This re-examination should determine not only that the participating Services' perceptions of the requirements have not changed, but also that the threat or other basis for establishing the system's need remains consistent with the initiating need.

In dealing with the contractor, the joint program manager must ensure that the interpretation of requirements within the scope of the contract comes *only* from the program office. There must be no other source, official or unofficial, stated or implied. This is the only way the joint program manager can maintain control of the program and hold the contractor accountable.

A joint program can be structured any way necessary to accomplish the program's goals. On the other hand, the base of experience for each type of joint program is small, and the advice and direction a new joint program manager receives (including that provided here) might have been formed from a joint program environment not at all similar to his own. Certainly the cost of a program, its importance, its urgency, and other factors which influence its visibility, will affect a joint program and its way of doing business. A joint mobile electric power (portable generator) program, for instance, will look different than a joint cruise missile program. The manager of each program will be influenced by different precepts even though both may be classified as "joint programs."

The DOD has established special arrangements for processing armaments and munitions requirements. An Armament/Munitions Requirements and Development (AMRAD) Committee has been established by the Deputy Secretary of Defense. The committee is staffed by members of the research and development directorates of the separate Services and reports to the Deputy Under Secretary of Defense (Tactical Warfare Programs). Although the objectives of most joint programs are outside the purview of AMRAD, the committee has more than 10 years experience in reconciling diverse requirements and has established a protocol for their harmonization. A program manager may find the committee's experience valuable.

Appendix A. MEMORANDUM OF AGREEMENT ON THE MANAGEMENT OF MULTISERVICE SYSTEMS/PROGRAMS/PROJECTS

1. PURPOSE

This Memorandum established policies for implementing multi-service systems, program/project management in accordance with DOD Directive 5000.1, "Acquisition of Major Defense Systems," 13 July 1971. It is the basic policy document for management of multi-service systems, programs and projects, and the framework within which, like DOD Directive 5000.1, acquisition management procedures must operate.

2. POLICY

The Service designated as the Executive Agent shall have the authority to manage the program/project under the policies and procedures used by that Service. The Program/Project Manager, the Program/Project Management Office, and, in turn, the functional elements of each Participating Service will operate under the policies, procedures, data, standards, specification, criteria and financial accounting of the Executive Service. Exceptions, as a general rule, will be limited to those where prior mutual agreement exists or those essential to satisfy the substantive needs of the Participating Services to accept certain deviations from their policies and procedures so as to accommodate the assumption of full program/project responsibility by the Executive Service. Demands for formal reporting as well as nonrecurring needs for information will be kept to a *minimum*.

3. RESPONSIBILITIES

a. The Executive Service will:

(1) Assign the Program/Project Manager

(2) Establish an official manning document for the Program/Project Manager Office which will incorporate the positions to be occupied by representatives of the Participating Services; e.g., Department of the Army Table of Distribution and Allowances (TDA)/Department of the Navy Manpower Listing/Department of the Air Force Unit Detail Listing (UDL). The manning document developed from the Joint Operating Procedure on Staffing will also designate a key position for occupancy by the Senior Representative from each of the Participating Services.

(3) Staff the Program/Project Management Office with the exception of the positions identified on the manning document for occupancy by personnel to be provided by the Participating Services. Integrate the Participating Service personnel into the Program/Project Management Office.

(4) Be responsible for the administrative support of the Program/Project Management Office.

(5) Delineate functional tasks to be accomplished by all participants.

b. The Participating Services will:

(1) Assign personnel to the Program/Project Management Office to fill identified positions on the manning document and to assist the Program/Project Manager in satisfying the requirements of all participants. Numbers, qualifications and specific duty assignments of personnel to be initially provided by each Participating Service will be reflected in the Joint Operating Procedure.

(2) The Senior Representative from each Participating Service will be assigned to a key position in the Program/Project Management Office and report directly to, or have direct access to, the Program/Project Manager. This key position could include assignment as Deputy to Program/Project Manager. He will function as his Service's representative, with responsibilities and authorities as outlined in Paragraph 3.d of the Agreement.

(3) Provide travel funds and support necessary for the accomplishment of the responsibilities of their representatives in the management of the Program/Project.

(4) Accomplish Program/Project functional tasks as specifically assigned in the Charter, in the Master Plan, and Joint Operating Procedures (JOPs), or as requested and accepted during the course of the Program/Project.

c. The Program/Project Manager will:

(1) Satisfy the specific operational, support and status reporting requirements of all Participating Services.

(2) Be responsible for planning, controlling, coordinating, organizing and directing the validation, development, production, procurement and financial management of the Program/Project.

(3) Review, on a continuing basis, the adequacy of resources assigned.

(4) Assure that planning is accomplished by the organizations responsible for the complementary functions of logistics support, personnel training, operational testing, military construction and other facilities, activation or deployment.

(5) Refer to the appropriate authority those matters that require decisions by higher echelons. The following items will be referred to appropriate authority:

(a) Deviations from the established Executive Service policy except as specifically authorized by the Program/Project documentation (reference Paragraph 4 below).

(b) Increases in funding of the Program/Project.

(c) Changes to milestones established by higher authority.

(d) Program/Project changes degrading mission performance or altering operational characteristics.

(e) Participating Service Senior Representative(s) within the Program/Project Management Office will:

(i) Speak for his parent Service in all matters subject to the limitation prescribed by his Service. Authority of the Service Senior Representative is subject to the same limitations listed above for the Program/Project Manager.

(ii) Refer to his parent Service those matters which require decisions by higher echelons.

4. DOCUMENTATION

Management for particular Multi-Service Program/Projects shall be documented by:

a. **A Multi-Service Program/Project Manager Charter.** The responsible Commander in the Service having principal Program/Project management responsibility will cause the preparation, negotiation and issuance of a jointly approved Charter which will identify the Program/Project Manager and establish his management office. The Charter will define his mission responsibility, authority and major functions, and describe his relationships with other organizations which will use and/or support the Program/Project. The Charter will describe and assign responsibility for satisfying peculiar management requirements of Participating Services which are to be met in the Program/Project, and will be jointly approved for the Headquarters of each involved Service by persons officially appointed to approve such Charters.

b. **A Program/Project Master Plan.** This is the document developed and issued by the Program/Project Manager which shows the integrated time-phased tasks and resources required to accomplish the tasks specified in the approved statement of need/performance requirements. The plan will be jointly approved for each involved Service by persons officially appointed to approve such plans.

c. **Joint Operating Procedures (JOPs).** These will identify and describe detailed procedures and interactions necessary to carry out significant aspects of the Program/Project. Subjects for JOPs may include Systems Engineering, Personnel Staffing, Reliability, Survivability Vulnerability, Maintainability, Production, Management Controls and Reporting (including SAR), Financial Control, Test and Evaluation, Training, Logistics Support, Procurement and Deployment. The JOPs will be developed and negotiated by the Program/Project Manager and the Senior Representatives from the Participating Services. An optional format is suggested in Attachment 1 to this Agreement. This action will be initiated as soon as possible and accomplished not later than 180 days after promulgation of the MultiService Program/Project Manager Charter. Unresolved issues will be reported to the Charter approving authorities for resolution.

d. **Coordination/Communication.** Where Participating Services are affected, significant program action, contractual, or otherwise, will not be taken by the Program/Project Manager without full consultation and coordination with the Participating Services while the matter is still in the planning stage. All formal communications from the Program/Project Management Office to higher authority in the Executive or Participating Services will be signed by the Program/Project Manager or his designated representative. Substantive change to the Charter, Master Plan, or JOPs will be negotiated with affected Participating Services prior to issuance as an approved change. No restrictions will be placed on direct two-way communications required for the prosecution of the Program/Project work effort, other than that required for security purposes.

We approve this Memorandum of Agreement and its implementing regulation.

/s/ HENRY A. MILEY, JR.
General, USA
Commanding General
US Army Materiel Command

/s/ I. C. KIDD, JR.
Admiral, USN
Chief of Naval Material
Naval Material Command

/s/ JACK J. CATTON
General, USAF
Commander
Air Force Logistics Command

/s/ GEORGE S. BROWN
General, USAF
Commander
Air Force Systems Command

20 July 1973

1. This memorandum of agreement is published as a joint regulation, AFLC/AFSC R 800-2.AMCR 70-59NAVMATINST 5000.10A.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Executive and International Management Department
Number: 8.3
Version: Original/Current
Date: December 1988

I. TITLE

International Programs

II. REFERENCES

—DOD 2100.3 (Foreign Assistance Policy)
—DODD 2010.4 (NATO Support)
—DODD 3100.3 (R&D Cooperation)
—DODD 2010.6 (NATO RSI)
—DOD 7290.3-M (FMS Financial Management)
—DODD 5530.3 (International Agreements)
—DODD 2050.1 (International Agreements)
—DODD 2040.2, (Technology Transfer)
—DODD 5230.11 (Foreign Disclosure)
—USD R&E, "Foreign Weapons Evaluation Program Element Implementation Guide"
—ITAR (Munitions Export)
—DODD 2000.9, (Co-Production Projects)
—DOD 5105.38-M (SAMM)
—DODD 2015.4 (Data Exchange Agreements)

III. POINTS OF CONTACT

Asst Sec Def (Intl Security Police) (ASD (ISP))
(202) 695-0942; AV 225-0942

Defense Security Assistance Agency (DSAA)
(202) 697-0098; AV 227-0098

Asst Dep CoS RD&A (Intl Prgms) USA
(202) 697-8187; AV 227-8187

Dir Tec Transfer Div USA
(202) 697-9676; AV 227-9676

Dir Strategy Plans & Policy USA
(202)695-5032; AV 225-5032

Dir RDT&E USN
(202) 697-5533; AV 227-5533

DCNO (Plans, Policy, Ops) USN
(202) 695-3707; AV 225-3707

Dep CoS RD&A USAF
(202) 695-7151

Chief Intl Affairs Div USAF
(202) 695-2251; AV 225-2251

Chief Intl Prgms USAF
(202) 697-0977; AV 227-0977

NOTE: See Addendum "International Programs Directives and Points of Contact," which provides matrix relating and international program to the appropriate DOD directive and to OSD and service points of contact.

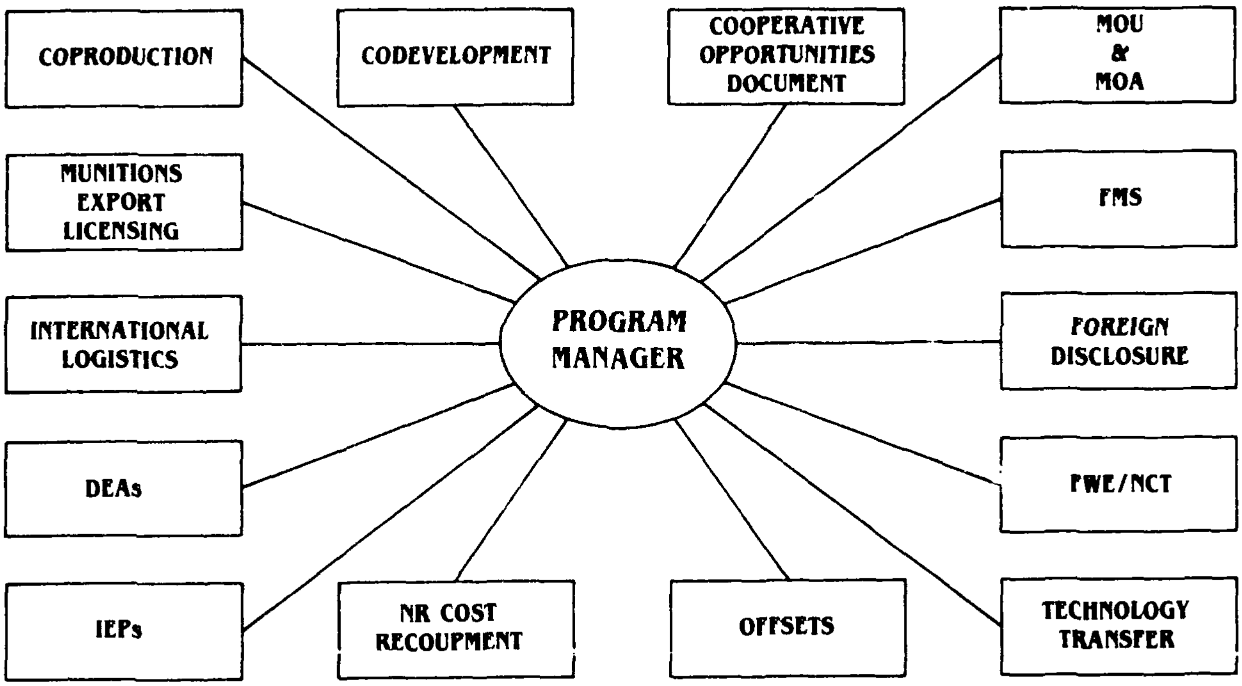
IV. PURPOSE AND SCOPE

This fact sheet is designed to:
—Provide a short description and orientiation to the PM of each international program and related elements.
—Summarize the importance of international programs to the PM
—Identify other factors of importance to the PM
—Assist the PM to manage the International programs environment (Figure 1)

V. POLICY

International programs have been an important part of United States foreign and national security policy for nearly four decades. The essential purposes of these programs are to enhance the defense posture of nations with which we share political, military and economic interests. Through foreign military sales (FMS), memoranda of understanding/agreement (MOU/MOA), data exchange agree-

Figure 1. INTERNATIONAL PROGRAM ENVIRONMENT



ments/information exchange projects (DEAs/IEPs), industrial participation (co-production/offsets), munitions licensing and foreign weapons evaluation (FWE), and NATO cooperative testing (NCT), the United States has enabled friendly nations to participate in, and share the burdens of, collective security. While these international programs are fundamental components, for mutual cooperation NATO rationalization, standardization and interoperability (RSI) cannot be overemphasized. RSI is an essential element of our foreign policy and must be addressed in enhancing commonality and reducing redundant expenditure of defense resources. These international programs complement and supplement our national defense position and contribute to the strength of our Allies. In short, the United States policy is to consider international programs an essential element of our global defense posture and a vital component of foreign policy.

VI. INTERNATIONAL PROGRAM—AN OVERVIEW

International programs involve much more than FMS, though it tends to dominate the spotlight due to the political sensitivity and high-dollar value of many of the sales. During recent years, there has been a tremendous growth in the number of international program agreements consummated between the DOD and its foreign counterparts. For the purposes of this fact sheet, the discussion of international programs is limited to the following:

—Foreign military sales
—Memoranda of agreement/understanding
—Information exchange projects
—Industrial participation (Co-production/offsets)
—Munitions licensing
—Technology transfer
—Foreign weapons evaluation

In every case, the program manager plays a pivotal role in identifying the need for negotiating, reviewing, and/or managing programs conducted pursuant to these international agreements. The sensitivity, visibility, impact and vital nature of these agreements affect the external environment of the program office and must be factored into the overall major system acquisition equation by the program manager. In other words, the program manager can't eliminate these programs, or isolate his program for them, —he must "manage" them. Awareness is the first rule of conduct. Understanding how they can impact the program is the second rule.

VII. INTERNATIONAL PROGRAMS—DEFINED AND CONCERNS OUTLINED

1. *Foreign Military Sales*—This fact sheet addresses FMS aspects of the security assistance program (and *not* the grant aid military assistance program (MAP) or the international military education and training (IMET) program). Foreign military sales involves the sale of military articles and services to foreign governments or international organizations (such as NATO) by formal agreements. These agreements (DD Form 1523 letter of offer and acceptance (LOA)) identify military articles or services to be sold, the general and special terms of the sale, and the estimated price. Specific procedures are well-documented and a mature system is in place throughout DOD to manage these programs. However, certain characteristics of FMS should be mentioned.

—FMS Program Manager Concerns. The program manager is responsible for "offering" a system to the foreign customer that is fully supportable throughout its life cycle. Before making the offer, the program manager must for major equipment sales, notify the Congress as required by Public Law 94-329, "The Arms Export Control Act", as amended, Section 36(b). This "36(b)" notification will receive high-level scrutiny. Another factor to be considered formally in offering the weapon system for sale under FMS procedures is the impact the proposed sale is expected to have on the domestic program. Again, the program manager's analysis of the impact will come under intense scrutiny. Three other points are worthy of note. First, the program manager should obtain the services of an FMS specialist early on. The unique forms, format and financial management requirements and the dedicated community supporting FMS can be "worked" most efficiently by a specialist. Second, the program manager can anticipate "care and feeding" of the foreign customer to a degree far in excess of that required of a service user. Third, properly manager, FMS can have a positive impact on the supportability of the domestic system and provide for a strengthening of the industrial base. This last aspect of FMS can most dramatically be realized through exercise of the special defense acquisition fund (SDAF), which provides funding directly to the program office for advance procurement of systems or long-lead items in anticipation of foreign demand. These funds are requested by the program manager in the year immediately before the year the PM desires to go on contract and *do not* affect program objective memorandum (POM) submissions, or program obligational authority. Material purchased using SDAF goes into the service inventory. When actual foreign demand materializes, issues from service stock are used to satisfy the demand.

2. Memoranda of Understanding/Agreement. MOU/MOA are written arrangements or understandings among governments and/or international organizations/agencies setting forth terms for cooperation in such work as research, development, production, procurement, or logistics. The MOU/MOA, signed at DEP/ASST SECDEF/Service Secretary level, identify and define in detail a joint project to be undertaken; e.g., scope of project, equipment or services to be provided, management, work scheduling, work sharing responsibilities, funding, logistics requirements, and other specific technical or management matters.

MOU/MOA Program Manager Concerns. Program managers should be aware of Umbrella MOU/MOA in force, which are contained in Appendix T of the Defense Federal Acquisition Regulation Supplement (DFARS). Based on this information, the Program Manager should assess his total current and potential international program involvement, especially with allied nations—NATO countries, Japan, Australia, and the Republic of South Korea. If the relationship warrants, the program manager should consider a project MOU/MOA to structure these complex relationships. The program manager can assure maximum control over the arrangement by requesting authority to negotiate the MOU/MOA on behalf of the United States. If actual negotiation is not possible, the PM should insist on a role in the negotiations. Project MOU/MOA make good sense by defining complex bilateral or multilateral relationships to assure coordination and avoid misunderstandings. The MOU/MOA provide specific "terms of reference" for individual tasks to be undertaken. Project MOU/MOA will normally require staffing with counsel, contracts, the comptroller, and activity foreign disclosure and technology transfer offices.

3. Data Exchange Agreements/Information Exchange Projects. DEA annexes provide for bilateral *no cost* exchange among designated project officers of classified and unclassified military information, between two governments under terms of a master DEA signed at SECDEF/Minister of Defense level. A DEA annex cites the master DEA and provides a project description and classification, identifies the establishment and authorities concerned, methods of transfer of the data, and other coordinating details. An IEP provides a written arrangement for exchange of U.S., classified and unclassified information with foreign governments, but have three characteristics that differentiate them from DEAs. First, an IEP can be bilateral or multilateral. Second, participants in an IEP are normally members of British Commonwealth nations. Third, data under DEAs are exchanged by the DEA project officer via the MAAG/ODC, whereas IEP data are exchanged via the pertinent attache office. As with MOU/MOA, staffing of new DEAs/IEPs will include counsel, comptroller, and the activity foreign disclosure and technology transfer offices.

—DEA/IEP Program Manager Concerns. The program manager will soon realize as he scans the large number of information exchange agreements in force that, to a significant degree, DEAs/IEPs involve transfer of data to foreign governments with very little flowing to the United States. Further, military information is a valuable resource and aggressive nations will seek to use DEAs/IEPs for maximum benefit and, to this end, will often request information out of scope of the cited DEA/IEP. The program manager, working with the pertinent DEA/IEP project officer, has a responsibility to ensure a "two-way street" is maintained, and to control releases under DEAs/IEPs to ensure only information applicable to the specific effort, and in accordance with national disclosure policy, is released. Unless the program manager identifies operative DEAs/IEPs that impact his program (or draft new agreements to manage requests for information) and develops an effective control system, the program manager may find himself in the role of referee for foreign government representatives and U.S. data source activities or, in the role of policeman if strict limitations of individual DEAs/IEPs have been violated. Neither role is desirable. Finally, the program manager is frequently the U.S. focal point for identification and coordination of requests of information that our foreign partner has and we need. Simply put, the program manager is responsible for knowing what information is out there and getting it. The DEAs/IEPs are ineffective if the United States is not benefitting from them to a degree commensurate with the benefit accruing to the foreign government.

4. Industrial Participation (Co-Production and Offsets). The term Industrial Participation is used to introduce important "facts of life" in major weapon system acquisition. Foreign governments recognize that modern U.S.-produced weapon systems can be expensive and their economies cannot absorb the cost burden. Among techniques employed to lighten this burden are local manufacture or assembly of the weapon system or, sales to the United States of goods and services to "offset" the value of the weapon systems; these goods or services *do not have to be defense-related.* Paraphrasing DODD 2000.9, "co-production" encompasses any program where the U.S. government, under an international program or indirectly through specific licensing arrangements by commercial firms, enables a foreign government, international organization, or a commercial producer to acquire the "know how" to manufacture or assemble, repair, maintain and operate, in whole or in part, a specific weapon, communication or support system, or an individual miltary item. Coproduction may be limited to the assembly of a few end-items with a small input of local country parts, or it may extend to a major manufacturing effort requiring the build-up of capital industries. In some programs the foreign country may be manufacturing items for *U.S. military consumption.* This can involve establishment of a "plant representative office" in the host nation to perform contract and administration functions.

—Industrial Participation Program Manager Concerns. The program manager will find his decision-making latitude restricted by the desire for or existence of industrial paticipation or "offset" agreements, especially when a major system FMS case is involved. Since DOD policy objectives focus on commonality inherent in RSI, the program manager may be forced to incorporate foreign service interoperability, broadening the base for common and interchangeable logistics, and improving

foreign source procurement, production, contract administration into the overall domestic program acquisition strategy. Even though the implementing agreement may establish industry-to-industry contracts, the program manager will be required to provide semiannual reports providing details of current production and status including anticipated monetary return to the United States, current problem areas, and future major events or milestones. The program manager may have little direct control over industrial participation but will be accountable for problem resolution and may be called to account if the program results in loss of U.S. employment. In short, industrial participation contains the potential for the same problems associated with developing a second source and is further complicated by volatile international politics and intense cross-cultural problems. The program manager will be expected to provide the leadership through this so-called minefield.

5. Munitions Licensing. This is under cognizance of the State Department and provides U.S. or foreign commercial entities with an authorization (license) to export U.S. defense articles and services. (NOTE: The Department of Commerce handles non-defense and dual-used military-civilian exports, and provides the enforcement mechanism for the Department of State to prevent unauthorized export of defense articles.) Munitions licensing is sometimes referred to as "export licenses" or "commercial-direct sales." For illustrations, it is useful to view munitions licensing as a two-step process. The first step involves a request to "market" the defense item. The license granted by State will authorize the company to "export" *only* data: brochures, general technical data, etc. If the marketing is successful, the company will present to the State Department, as a second step, evidence of a signed contract for sale of the item to a foreign customer and request authorization to export the hardware. Each of approximately 40,000 license requests State receives each year is handled on a case-by-case basis. Most decisions are made on-the-spot by State's Office of Munitions Control. However, approximately 10 percent are submitted to DOD for review to assist State in its consideration of the license application. This is to ensure that licenses involving critical technology receive special scrutiny to protect advanced military operational capabilities and associated technology. Program offices provide input related to the impact of the license request on the production base, logistic support, security, technology transfer, foreign disclosure and DOD sunk costs of the domestic program. Program office response in most instances will be under a short-fuze and State can approve/deny the license application with or without DOD input. The obvious potential of release of sensitive military technology (oftentimes developed with DOD R&D funds) through the media of export licenses has not been overlooked within DOD. The entire subject is being intensely debated.

—Munitions Licensing Program Manager Concerns. The program manager will be the focal point for developing prompt, coordinated responses to requests from State on munitions licenses. If the program manager's position is to recommend denial of the license application and that recommendation is upheld, the program manager can expect a visit from an industry representative seeking a modification of the program manager's position. Remembering the two-step nature of the process, program manager action will either deny industry an opportunity to market, or deny industry a profit opportunity from the signed contract. Another twist: Public Law requires recoupment of non-recurring costs (both R&D and production) from commercial sales where the product was developed using DOD funds. In this regard the program manager has three responsibilities. First, he must ensure appropriate FAR (defense supplement) clauses are included in all R&D contracts. These clauses require the contractor to notify the government if a commercial sale is made of items developed under R&D contracts and obtain pro rata share to permit the contractor to repay this share for each item sold. Second, the program manager must develop a non-recurring cost (NRC) recoupment pool, calculate the pro rata share and provide this information to the contractor. Third, the program manager must ensure that the contract administrator (DCAS, AFPRO, NAVPRO, ARPRO, etc.) enforces contract provisions, and the contractor sends a check made out to the U.S. treasury for deposit in a miscellaneous receipts account. Here's the rub: No feedback mechanism is in place (nor does State feel obligated) to inform DOD when a license for export of hardware has been approved. The program manager must rely entirely on the contractor to report State-licensed sales. The con-

tractor has no incentive to do so since the pro rata share is included in his sales price which may make his product less competitive in the world market. In short, in this arena, the program manager is responsible but has little visibility over the process and less leverage for effective enforcement. A revised DODD 2140.2, "Recoupment of Nonrecurring Costs on Sales of U.S. Products and Technology," is expected to be published shortly.

6. Technology Transfer. Technology Transfer is not an international program in the sense the above mentioned are. Rather, technology transfer is an issue that pervades all international programs which are mechanisms for transfer of U.S.-developed weapons technology overseas. The challenge is to transfer technology consistent with U.S. national security and foreign policy objectives, ensuring such transfer does not constitute an unreasonable risk to U.S. security, and to receive a positive benefit in expanding the defense industrial base while restricting transfer of technology to our potential adversaries. It is obvious that without controlled transfer of technology, potential adversaries have great opportunities to shorten threat hardware development leadtimes and substantially reduce corresponding costs.

Technology Transfer Program Manager Concerns. The program manager must remain aware that technology transfer pervades international programs and that his leadership is needed to ensure the objectives of such transfer are achieved. Foreign disclosure, the authorized transfer of *classified* military information to foreign governments or international organizations, needs careful attention. Program managers need no education in the importance of handling classified material; however, the following outline identifies key documents and institutions with which the program manager should be familiar:

—National Disclosure Policy (NDP-1)

—Coordinating Committee of Multilateral Export Controls (COCOM)

—DOD Militarily Critical Technology List (MCTL)

—DOD International Technology Transfer (IT^2) Panels and Subpanels.

Foreign Weapons Evaluation. Funds are provided by the Congress under a discrete Program Element (PE 6511D) to provide for technical and/or operational evaluation of foreign nations' weapon systems and technologies to determine their potential use to DOD components. This program element, managed by the director, defense test and evaluation (DDT&E), in coordination with the deputy USDR&E for International Programs and Technology, is a part of the test and evaluation, defense appropriation.

—FWE Program Manager Concerns. The program manager may submit a FWE Candidate Nomination Proposal (CNP) approximately 16 months before the desired evaluation fiscal year for *any* foreign system that has the potential to satisfy an existing or projected operational or training requirement. Together with the CNP, the program manager will outline specific arrangements under which the U.S. government and/or U.S. industry could use the candidate system and technology. These specific arrangements could include MOU/MOA, industry-to-industry agreements, contracts or other cooperative technology exchange programs. The benefits to program managers are clear. Through FWE, an opportunity exists to take advantage of a developed system and technology to meet a requirement without a large expense or lengthy development lead time. It is unlikely that FWE would provide a total weapon system; however, foreign developers may fill a vital system or subsystem "niche" in a major DOD program.

VIII. SUMMARY

It's no secret that the program manager's job grows more complex and demanding each year. International programs and the issue of technology transfer are among the drivers of this growing complexity. The message is to "manage" these programs as the program manager manages other elements of the program and to realize international programs are more than just FMS. In fact, even FMS specialists may be largely ignorant of this larger spectrum. The foreign policy and national security goals of the United States are not, as this fact sheet demonstrates, a seamless array. Rather, they are a patchwork of concepts, institutions, and practices, often at odds with each other, through which the program manager must work. The program manager can ease this burden by profiting from previously recognized lessons learned:

—Most all major system acquisition programs involve international agreements.

—Obtain the services of an FMS specialist early on.

INTERNATIONAL PROGRAMS
DIRECTIVES AND POINTS OF CONTRACT (POCs)

PROGRAM	DOD DIRECTIVE	ARMY DIRECTIVE	NAVY DIRECTIVE	A.F. DIRECTIVE	DOD POC*	ARMY POC*	NAVY POC*	A.F. POC*
MOU/MOA	DOD 5530.3 DOD 2050.1	AR 70-41 AR 70-33	SECNAV 5710.25 SECNAV 5000.31 OPNAV 5710.24	AFR 80-21	D1 D7	A1 A2	N1 N2	AF1
DEA/IEP	DOD 5530.3 DOD 2050.1 DOD 2015.4	AR 70-33	SECNAV 5710.25 OPNAV 4900.80 OPNAV 5710.24	AFR 80-21	D1 D7	A1 A2	N1 N2	AF1
INDUSTRIAL PARTICIPATION COPRODUCTION OFFSET	DOD 5530.3 DOD 2050.1 DOD 2000.9	AR 12-1 AR 12-8	SECNAV 5710.25 SECNAV 4920.4A OPNAV 5710.24	NONE	D1 D7	A1 A2	N1 N4	AF5 AF1
MUNITIONS LICENSING	DOD 2040.2 DOD 5230.11 DOD 2140.2	CSR 12-1 AR 12-6	OPNAV 4000.36F	NONE	D2 D1 D7	A1	N3	AF2
TECHNOLOGY TRANSFER	DOD 2040.2 DOD 5230.11 DOD 2140.2	MOA on T2 HQDA LTR 70-85-1 DAMI-2D Concept Paper 22 Oct 84	SECNAV 4920.4D SECNAV 4900.5F SECNAV MEMO of 2/9/78 OPNAV 5510.156 SECNAV 5710.8A OPNAV 5510.94E	AFR 80-21	D3 D1 D2 D7	A3 A1	N3	AF1 AF2
FMS/IMET/MAP	DOD 2110.33 DOD 2100.3 DOD 7290.3M DOD 5105.38M DOD 2040.2 DOD 2140.2	AR 12-1 AR 12-2 AR 12-5	SECNAV 4900.5F SECNAV 4900.26A OPNAV 4900.149	AFR 400-3	D4 D6 D7	A2 A4	N4	AF3
FOREIGN WEAPONS EVALUATION	USDR&E "FWE Prog Elem Implementation Guide"	Draft Regulation 380-26	SECNAV 5000.31 OPNAV 5710.24	NONE	D5 D7	A2	N1	AF4

* POC's are keyed to detailed addresses in TABS

—Be aware of political sensitivity and your limited control over industrial participation.

—Program managers can assure maximum control by requesting authority to negotiate MOU/MOA.

—DEAs/IEPs must be implemented skillfully to ensure a two-way flow of information.

—Deadlines must be met in reviewing munitions licenses to ensure service input.

—Program managers are responsible for enforcement of NRC recoupment.

—Technology transfer is involved in all international programs.

—Foreign weapons evaluation may help you meet your program requirements.

DOD POCs

D1 Office of the Secretary of Defense
Deputy Assistant Secretary
(International Security Policy)
Director Munitions Control
Cafritz Bldg.,
Tel. 695-3554

D2 Office of the Secretary of Defense
Deputy Assistant Secretary
(International Security Policy)
Strategic Trade Policy Division
1211 South Fern St.,
Arlington, Room C110B,
Tel. 694-6389

D3 Defense Security Assistance Agency
Executive Officer.
The Pentagon, Room 4E-841,
Tel. 697-0098

D4 Office of the Secretary of Defense
Executive Assistant to the Director
Defense Test and Evaluation
The Pentagon, Room 3E-1060
Tel. 695-4608

D5 Office of the Secretary of Defense
Deputy Under Secretary (Acquisition Management)
Director International Acquisition
The Pentagon, Room 2A-326,
Tel. 697-9351

D6 Defense Systems Management College
Director, Multinational Program Management
Christopher Nygren, Fort Belvoir, VA,
Tel (703) 664-6121

ARMY POCs

A1 Army Chief of Staff
Assistant Chief of Staff for Logistics (SA)
Security Assistance Policy Coordination Office
The Pentagon, Room 3D561,
(DALO-SAZ-A),
Tel. 694-4272

A2 Army Chief of Staff
Deputy Chief of Staff for Research, Development and Acquisition
International Office (DAMA-IN)
The Pentagon, Room 3E413,
Tel. 697-7879

A3 Army Chief of Staff
Assistant Chief of Staff for Intelligence
Counter Intelligence Directorate
Technology Transfer Division
The Pentagon 2D475,
Tel. 697-9679

A4 Army Chief of Staff
Deputy Chief of Staff for Operations and Plans
Strategy, Plans and Policy Directorate
Security Assistance Division (DAMO-SSA)
The Pentagon, Room 3B516,
Tel. 697-5293

NAVY POCs

N1 Office of the Chief of Naval Operations
(Program Sponsor and OP-61, -62, -63, and-098)

N2 Office of the Chief of Naval Operations
Office of Research, Development, Test and Evaluation (OP-098)
Assistant for International Research and Development (OP-098F)
The Pentagon, Room 5C658,
Tel. 695-7608

N3 Office of the Chief of Naval Operations
Director, Technology Transfer Policy and Control Division (OP-62)

Head Technology Transfer Policy (OP-621)
The Pentagon, Room 4E-542,
Tel 697-0889

Head, Technology Transfer Control Branch (OP-623)
The Pentagon, Room 4E549,
Tel. 697-0921

N4 Office of the Chief of Naval Operations
Deputy Director, Security Assistance Division (OP-63B)
Crystal Plaza 6, Room 580,
Tel. 692-7260

AIR FORCE POCs

AF1 Deputy Chief of Staff, Research, Development and Acquisition (AF/RD)
Special Assistant for International Cooperative Research, Development and Acquisition
The Pentagon, Rm. 4D260,
Tel. 695-2014

AF2 Office of the Vice Chief of Staff (AF/CV)
International Affairs Division (AF/CVAI)
Munitions and Export Control Branch (AF/CVAIM)
The Pentagon, Rm. 4C1074,
Tel. 697-4620

AF1 Deputy Chief of Staff Programs and Resources (AF/PR)
Directorate of International Programs (AF/PRI)
The Pentagon, Rm. 5A334,
Tel. 70977

AF4 Deputy Chief of Staff Research Development and Acquisition (AF/RD)
Directorate of Operational Requirements (AF/RDQ)
Tactical Weapons Div. (AF/RDQA)
The Pentagon, Rm. 4D337,
Tel. 697-3628

AF5 Deputy Chief of Staff Programs and Resources (AF/PR)
Directorate of International Programs (AF/PRI)
Weapons Programs Division (AF/PRIP)
The Pentagon, Rm. 5B332,
Tel. 697-0072

INTERNATIONAL PROGRAM ACRONYM DICTIONARY

AECA	Arms Export Control Act
AFPRO	Air Force Plant Representative Office
ASD(ISP)	Assistant Secretary of Defense, International Security Policy
ARPRO	Army Plant Representative Office
CNP	Candidte Nomination Proposal (FWE)
COCOM	Coordinating Committee for Multilateral Export Controls
DCAS	Defense Contract Administration Service
DDT&E	Director, Defense Test and Evaluation
DEA	Data Exchange Agreement
DODD	Department of Defense Directive
FAA	Foreign Assistance Act
FAR	Federal Acquisition Regulations
FDRB	Foreign Disclosure Review Board
FWE	Foreign Weapons Evaluation
IEP	Information Exchange Project
IMET	International Military Education & Training
ITAR	International Traffic in Arms Regulations
IT^2	International Technology Transfer
MAAG	Military Assistance Advisory Group
MAP	Military Assistance Program
MCTL	Military Critical Technology List
NATO	North Atlantic Treaty Organization
NAVPRO	Navy Plant Representative Office
NDP	National Disclosure Policy
ODC	Office of Defense Cooperation
POM	Program Objective Memorandum
PM	Program Manager
RSI	Rationalization, Standardization and Interoperability
R&D	Research and Development
SAMM	Security Assistance Management Manual

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Authors: DSMC, Executive and International Department
Number: 8.4
Version: Original
Date: December 1988

I. TITLE

International Considerations

International Technology Sharing/Transfer Control

II. REFERENCES

—DOD Directive 2010.6 (NATO-RSI)

—DOD Directive 2040.2 (Technology Transfer)

—DOD Directive 5230.25 (Withholding of Unclassified Technical Data from Disclosure)

—DOD Directive 5530.3 (International Agreements)

—*Guide for the Management of Multinational Programs*, Second Edition, Defense Systems Management College, 1987

III. POINTS OF CONTACT

Assistant Secretary of Defense (Production and Logistics), (202) 695-6639

Deputy Under Secretary of Defense (Industrial and International Programs) (202) 694-4172

Deputy Under Secretary of Defense (Trade Security Policy), (202) 693-1158

Director, Defense Technology Security Administration (DTSA), (202) 694-6550

IV. PURPOSE AND SCOPE

This fact sheet is designed to:

—Provide a summary of DOD policy regarding technology sharing/transfer control

—Provide an outline of technology transfer control procedures

—Provide insights for program managers regarding how to implement DOD policy in the best way.

V. BACKGROUND

There is an apparent paradox. How can a nation control technology it is sharing or transferring internationally? The explanation of this paradox is that a nation cannot control technology it is sharing internationally, but it can control the sharing or the transferring process (or at least attempt to do so). That is what the U.S. policy is designed to do. On the one hand it encourages the sharing of technology with our allies and friends, while on the other hand denying that technology to our potential enemies and any nation not willing to protect it to the same extent that our nation does.

Sharing with Friendly Nations

Sharing of technology is a policy of the NATO Alliance as well as the United States. As stated by Secretary of Defense Carlucci in the cover letter to his 1988 report to the Congress on "Standardization of Equipment Within NATO": "NATO countries have moved to conserve resources by coproduction of *advanced* systems." The most effective use of resources is to eliminate duplicative independent national R&D programs, and early technology exchanges are clearly seen as a way to use resources more efficiently toward the Alliance's common good. By cooperatively developing defense systems, individual nation's cost for developing similar systems to meet the same requirement can be eliminated, saving not only the R&D cost, but at the same time ensuring standardization and interoperability of the Alliance's equipment.

Denying Technology to Unfriendly Nation

Rather than try to match the enemy's quantity of weapons, the United States and its allies have sought to gain advantage through the exploitation

of superior technology in their weaponry. Protecting that superior technology takes on great importance, as has been seen and reported publicly in the past few years. Recognizing that it is not possible to protect a given technology forever, U.S. policymakers have concluded that it is both possible and necessary to protect technological lead times.

As a part of the United States' effort to protect those lead times, DOD has instituted the technology transfer control program. "The technology transfer control program is the management mechanism by which the Department of Defense discharges its responsibility for participation in the regulation of military-related exports of goods, services, munitions, and technology under the Export Administration Act of 1979 and the Arms Export Control Act. The Under Secretary of Defense for Policy has the responsibility to coordinate the DOD policy on technology transfer. He is supported in this role by the Under Secretary of Defense for Acquisition who is responsible for management of overall DOD technical efforts. Together, and with cooperation from other DOD components, these under secretaries shape a program which coalesces policy. Operational and technical personnel throughout DOD provide the Department of Commerce and the Department of State with DOD recommendations on the transfer of technology. In the process, major efforts are directed toward improving interagency and international cooperation, engaging experts from industry and academia to assist in identifying militarily critical technologies and in recommending certain export control procedures, and appropriately informing U.S. industry, academia and the public of the impact of technology transfer on the East-West operational military balance.

VI. DOD POLICY

International cooperation has an integral element, the transfer of technology among the partners in a cooperative process. As such, there is a need for the program manager to understand the process by which technology flows from one partner to another. Technology transfer is an integral part of codevelopment, coproduction and licensed manufacturing. Technology transfer is the process of transferring, from the industry in one country to another or between countries, technical information relating to the design, engineering, manufacturing and production techniques for hardware systems using recorded or documented information of a scientific or technical nature. It normally does not include the transfer of common reference documentation such as military standards, specifications, handbooks or commercial counterparts to these documents.

It is DOD policy to treat defense-related technology as a valuable, limited national security resource, to be husbanded and invested in pursuit of national security objectives. Consistent with this policy and in recognition of the importance of international trade to a strong U.S. defense industrial base, the Department of Defense shall apply export controls in a way that minimally interferes with the conduct of legitimate trade and scientific endeavor.

Additionally, as stated in Public Law 94-361, it is the policy of the United States that equipment procured for U.S. forces employed in Europe under the terms of the North Atlantic Treaty should be standardized or at least interoperable with equipment of other members of NATO. Accordingly, the Department of Defense shall initiate and carry out methods of cooperation with its Allies in defense equipment acquisition to improve NATO's military effectiveness and to provide equitable economic and industrial opportunities for all participants. The Department of Defense will also seek greater compatibility of doctrine and tactics to provide a better basis for arriving at common NATO requirements. The goal is to achieve standardization of entire systems, where feasible, and to gain the maximum degree of interoperability throughout Alliance military forces.

DOD components shall manage the transfer of technology, foreign intelligence, and military information, consistent with the terms of applicable U.S. laws and regulations to include the International Traffic in Arms Regulation (ITAR). Specifically, DOD Components shall:

a. Include political-military considerations to determine the releasability of technical data and other information.

b. Foster an early mutual exchange of technological and other information with NATO allies to promote the development and adoption of standardized or interoperable weapons systems and equipment of NATO nations in accordance with DOD

Directives 5000.1, 5000.3, 2040.2, 5530.3, 5230.25 and DOD Instruction 2015.4.

c. Conclude international agreements, when required for classified data exchange. See DOD Directive 5230.11, DOD Directive 5530.3, and DOD Instruction 2050.1.

d. Take action to provide quaified contractors from NATO nations with the classified and unclassified information necessary to compete for U.S. military contracts.

e. Foreign participation as subcontractors to U.S. prime contractors shall be encouraged, as well as U.S. industry performing as subcontractors to NATO prime contractors.

f. A report to the Foreign Disclosure Automated Data System on DD Form 1822, Report of Disclosure or Denial of U.S. Classified Military Information, must be completed within 15 days of all disclosure actions related to equipment standardization or interoperability in NATO.

VII. PROCEDURES (per DODD 2040.2)

In all technology transfer cases referred for review, the DOD components concerned shall:

a. Consider proposed transfers of technology, goods, services and munitions on a case-by-case basis.

b. Conduct policy reviews, technical evaluations, operational and military mission impact assessments, and intelligence assessments of proposed transfers.

c. Ensure that transfers of technology, goods, services and munitions:

(1) Are consistent with U.S. national security and foreign policy objectives.

(2) Do not constitute an unreasonable risk to U.S. security in the degree to which they reduce technological and U.S. industrial leadtimes.

(3) Receive positive consideration when such transfers will result in tangible and direct benefits to the defense objectives of the United States and its allies or to the defense industrial base. Such benefits should be at least equivalent to the value of the technology transferred.

d. Make sensitive transfers conditional upon agreements with allied and other nations that restrict the transfer of technology, goods, services, and munitions that harm or may harm the security of the United States and the security of U.S. allies and other friendly nations.

e. Limit the transfer to any country or international organization of advanced design and manufacturing know-how to those transfers that support specific national security or foreign policy objectives.

f. Oppose transfers of sensitive technology, goods, services, and munitions through multinational organizations in which potential adversaries participate.

g. Assess whether recipient nations:

(1) Restrict their transfer or export of U.S. technology, goods, services, and munitions to other nations who use, or may use, such technology, goods, services, and munitions against the best interests of the United States.

(2) Secure written U.S. Government agreement before exporting U.S. technology, goods, services, and munitions.

(3) Maintain control over U.S. technology, goods, services, and munitions.

(4) Report promptly and fully to the U.S. Government any known or suspected transfers of U.S. technology, goods, services, and munitions that do not have U.S. Government approval.

(5) Transfer non U.S. critical technology, goods, services, and munitions harmful to U.S. security.

h. Assess annually the total effect of transfers of technology, goods, services, and munitions on U.S. security, regardless of the transfer mechanisms involved.

i. Support approved DOD programs designed to inform government, the Congress, industry, academia, and the public on the dangers of the loss of Western technological leadership.

VII. INSIGHTS FOR PROGRAM MANAGERS

When reviewing the possible technical alternatives for solution of a military requirement, early consideration of sharing the technology with our allies and friends should be given by both developer and user. At the same time, the criticality of the technology and the need to protect the technology, its new application, or the manufacturing technique must be assessed.

If the possibility exists for international sharing of the technology/weapon system, explore that possibility within Service headquarters and the OSD to see what is already being done with that technology internationally, perhaps by other Services.

If international sharing is a possibility, visit a PMO/SPO that has been or is already involved in such a program. Many valuable lessons have already been learned; they need not be learned anew.

A Technology Security Risk Assessment (TSRA), a precondition for negotiations, must be initiated by the project officer but actually prepared by technical experts in coordination with disclosure officers and intelligence agencies. The TSRA must itemize all sensitive data involved, assess the risk to U.S. national security posed by the proposed transfer and identify foreign technologies or other benefits the United States will accrue. The cognizant military department must then translate the TSRA into appropriate negotiation guidance. This guidance must outline technologies which cannot be shared and those which will be shared only on a limited basis. A technology control plan is then developed which outlines the technologies to be transferred, the time phasing for the transfers, and the normal and special security/protective measures required.

Get acquainted with the OSD international programs and technology officer in OUSD(A) and the technology control staff officer in DUSD(TSP and DTSA). Service headquarters representatives should know these OSD individuals.

Early coordination with DTSA by the project officer and by the U.S. industries involved to discuss releasability and licensing requirements is highly encouraged.

Much effort has been made by all NATO nations to facilitate this type of cooperation. Problem areas like acquisition procedures, contractual laws, specifications and standards, monetary exchange rates, patent laws, data rights, cost accounting procedures, and allowable/non-allowable costs are a few of the issues currently being addressed within DOD.

INSERT TAB 9

OTHER

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Executive and International Department
Number 9.1
Version: Update
Date: January 1989

I. TITLE

The Defense Systems Management College

II. REFERENCES

—DSMC Catalog

—DOD Directive 5160.55 "Defense Systems Management College"

—DOD Directive 5000.52 "Defense Acquisition Education and Training Program"

III. POINTS OF CONTACT

Academic Information
(703) 664-2152; AV 354-2152

Academic Support
(703) 664-1098; AV 354-1098

Consultant Services
(703) 664-4795; AV 354-4795

Research Services
(703) 664-4795; AV 354-4795

Program Management Support Systems Services
(703) 664-5783; AV 354-5783

Information Services (Library)
(703) 664-2900; AV 354-2900

Publication Services
(704) 664-5082/5992; AV 354-5082/5992

IV. PURPOSE AND SCOPE

This fact sheet is designed to:
—Present the mission and organization of the College
—Summarize the ongoing academic activities of the College
—Identify other services available.

V. DOD POLICY

See VI. below.

VI. DOD ROLE

The Defense Systems Management College (DSMC), founded on 1 July 1971, is a joint Military Service and/or Office of the Secretary of Defense professional military institution operating under the direction of a Policy Guidance Council (PGC), chaired by the Under Secretary of Defense (Acquisition) (USD(A)), to support acquisition management and to assist in fulfilling education and training requirements set out in appropriate references.

VII. DSMC MISSION

—To conduct advanced courses of study in management of the acquisition of defense systems as the primary function of the College

—To conduct research and special studies in defense acquisition management

—To assemble and disseminate information concerning new policies, methods, and practices in defense acquisition management

—As the DOD executive agent, to provide oversight for the DOD education and training program for the acquisition work force.

VIII. DSMC ORGANIZATION

Policy Guidance Council

Acting for the Secretary of Defense in governing the College, the DSMC Policy Guidance Council was established in September 1970.

The Council: (a) establishes policy, provides guidance, and acts as prime jurisdictional agent for the operation and administration of DSMC; (b)

approves the admissions policy and curricula for each new DSMC course; (c) approves the nomination of the DSMC Commandant; and (d) approves the nomination of each member of the DSMC Board of Visitors.

The Council meets with the Commandant to review operations and approve the five-year plan.

Acquisition Enhancement Program Office

The Acquisition Enhancement (ACE) Program Office provides the DSMC Commandant and the Office of the Under Secretary of Defense (Acquisition) (USD(A)) full-time oversight for DOD mandatory and certified equivalent acquisition courses. It coordinates development and revision of mandatory courses, ensuring that unusual or special education and training requirements throughout DOD are addressed and satisfied. The ACE Program Office promotes and shares non-traditional instruction and technology efforts and results with sponsoring DOD component schools. It facilitates communications among the schools. It promotes high-quality acquisition management education and seeks to avoid duplication in the DOD mandatory course curricula. Based on inputs from DOD components, ACE prepares and submits the budget for funding resources associated with the quota allocation process for OSD-mandated acquisition courses. The ACE Program Office and the DOD components develop alternate education and training programs, including non-DOD and contract activities and criteria, to provide the competency based equivalencies to the mandatory courses. It develops and proposes policy recommendations to the Policy Guidance Council and the USD(A) regarding the education and training acquisition program. The ACE Program Office is supported by two groups—the Inter-Service ACE Program Action Group comprising DOD component representatives, and the Curriculum Advisory Council representing DOD component schools.

Center for Acquisition Management Policy

The Center for Acquisition Management Policy (CAMP) provides DSMC the capability to conduct analyses of issues relevant to defense acquisition policymakers and to recommend constructive changes. It identifies redundant issues relevant to U.S. Government laws, policies and procedures. These concern: (1) acquisition (mission area analysis, coupling with force-structure planning, technology, system definition, design, development, test and evaluation, and production), deployment, logistics maintenance, use (include coupling with doctrine and tactics), upgrading, and phase out of defense-related systems; and (2) availability, procurement, maintenance and use of defense-related material (raw materials, suppliers, components, weapons). The CAMP analyzes selected issues, giving particular attention to developing comprehensive understanding of constraints, relationships among relevant factors, and opportunities for beneficial changes in acquisition policy and procedures.

The CAMP disseminates analyses results to appropriate persons and groups and proposes specific changes in acquisition policy and procedures to senior-level policy officials; e.g., members of the Policy Guidance Council.

The CAMP is a consultancy for acquisition issues and problems. It develops and presents papers, articles, studies, and analytical/reportive material to support the evolution and promulgation of public policy on defense acquisition matters.

The CAMP conducts and sponsors defense acquisition policy research projects and initiatives to achieve substantive policy and structural improvements in the internal defense acquisition process.

Finally, the CAMP is a quick-response consultative and advisory resource on major defense acquisition issues to the Department of Defense Acquisition Executive and senior Defense officials, the Congress, acquisition policymakers and senior acquisition executives of the military services, and the Policy Guidance Council.

Executive Institute

The Executive Institute provides DSMC the experience of senior systems acquisition managers in order to carry out the following objectives:

—Expose students to the "big picture" and top-level point of view

—Assist in developing innovative course material

—Conduct and promote interaction with executives in government, industry and academia.

The Executive Institute comprises chairs similar to an endowed chair at a civilian university. The DSMC chairs have backgrounds in industry, the

Army, the Navy and the Air Force. Industry chairs, designated the James Forrestal Memorial Chair and the John H. Richardson Chair, are supported by the National Security Industrial Association (NSIA) and American Defense Preparedness Association (ADPA), which nominate incumbents, subject to approval of the Commandant. The Chair of Acquisition Policy is appointed by the Commandant. Occupants of Service chairs are nominated by military departments and are members of the Senior Executive Service. Appointments are for a finite term and must be approved by the Commandant.

Members of the Executive Institute have broad latitude in carrying out objectives of the Institute. Presentations to students in various classes, both the Program Management Course (PMC) and short courses, concern fundamental issues and objectives of systems acquisition management and particular areas of members expertise. Members consult with individuals and groups of DSMC faculty and students and maintain an "open-door" policy.

Institute members engage in research activities and contribute papers to professional journals. Upon request, they provide consultation to organizations within the Department of Defense.

Institute members find it possible, in an establishment of higher learning, to continue their education by attending College classes.

School of Systems Acquisition Education

The School of Systems Acquisition Education (SE) conducts the PMC and a number of management-oriented short courses. The PMC curricula treats all aspects of program management in an integrated manner and provides a comprehensive overview of DOD acquisition policy. The short courses are structured to meet the special needs of selected program managers and intermediate-level functional managers.

The SE executive management courses are designed to update or maintain the currency of senior-level managers in the DOD or organizations that have defense-related responsibilities.

The systems acquisition education curricula is updated continually to keep abreast of current management practices and to lead the development of new methods. Each faculty member maintains a close liaison with the military departments, other educational institutions, industry and business organizations, and professional societies. The SE has developed a distinguished guest lecturer program as an essential part of the College curricula. This program is designed to make possible maximum interaction among students and top-echelon policymakers and recognized experts from DOD, the Congress, the General Accounting Office, other government agencies, and the academic community. Further, an industry program has been put in place during which student groups visit production facilities of a major defense contractor to review program activities. The Service and industry program managers interact with the students to support student development of issues and focus for the industry visitations.

Members of the faculty conduct research within the specialty areas and publish the results in professional and Service journals. Faculty members also provide consulting assistance to program offices and industry groups on request.

Department of Research and Information

System acquisition management research, and the assembly and dissemination of information concerning policies, methods, and practices in defense acquisition management, two of the College's four missions, are the responsibility of the Department of Research and Information (DRI).

The *Research Directorate* manages the College's overall program of applied acquisition research. Developing innovative solutions for today's problems, which actively probe the forefront of tomorrow's issues, the program's fundamental purpose is to improve the acquisition process and its management. To that end, it supports the continuing development of the College curricula, develops new management techniques for use by program management offices, and assists in formulating acquisition policy.

The *Decision Support System Directorate* is developing the Program Manager's Support System (PMSS). The PMSS is an application of decision support system techniques in the defense program management environment. The objective of this project is to develop software tools that can be used as decision aids in the classroom at the College and will provide management tools for program management offices throughout the Services.

The DSS Directorate is also conducting research into applications of other decision support system tools.

The *Education Research Directorate* is the long-range education process planning arm of the College. This team monitors defense acquisition trends, analyzes Service educational needs, and develops subject matter and teaching concepts that could be introduced into DSMC curricula in the future.

The *Publications Directorate* helps to disseminate acquistion management information through publication of a periodical and a number of special acquisition or management-oriented dcocuments.

The *Information Directorate (Library)*provides information and reference services to DSMC students, faculty and staff, and to the system acquisition management community.

Department of College Operations and Services

The Department of College Operations and Services (DCOS) is responsible for the general day-to-day business management and functional support operations for the College. The major functions of the department are:

—College financial and manpower planning and management
—Procurement and contracting for College services and material
—Civilian and military personnel administration support for students, staff and faculty
—Student admissions and registrations processes
—Protocol assistance to the Commandant, staff, faculty and students
—Graphic arts, photography, duplicating, printing, audio, television production and recording, and equipment maintenance in support of the College missions and curricula
—Daily operation, upgrade and long-range planning for all College buildings and facilities
—Automation equipment installation and maintenance
—Computer operation and management of information processing.

IX. ACADEMICS

Currently, the environment of defense system acquisition is an ever-changing mosaic of requirements, budgetary constraints, technological capabilities and political/strategic considerations. Preparing a manager to work effectively within this environment requires a dynamic education program that blends abstract concepts with real-world experience. The courses offered by DSMC are designed to respond to this need. They are intended to introduce the student to the world of systems acquisition and prepare him or her to function effectively within it. The content of each course and subcourse is continuously monitored and altered when necessary to reflect changing real-world conditions. Additionally, new short courses are developed periodically to answer the needs of a specific management group or in response to requests of other government agencies.

The courses are conducted by a civilian and military faculty, whose efforts are complemented by guest lecturers from government, industry, and the academic communities. The College's non-attribution policy is designed to encourage guest lecturers to take part in open, candid discussions with students. Such interaction enhances the real-world flavor of the DSMC experience.

The following pages list the courses to be offered by the College. This listing is tentative, as the College administration believes that flexibility is essential in acquisition education. For more specific information about the courses and the course schedules, call the office of the Registrar.

Regional Centers

Steady increase in the complexity of modern military systems is paralleled by the steady increase in the complexity of the process used to acquire them. Even if all current efforts to streamline that process prove successful, the challenge of meeting expanded requirements with reduced funding will make the job of the acquisition manager more demanding and complex. Thus, the need for acquisition managers who are trained and fully prepared to guide and direct important defense systems acquisition programs is greater than ever before.

Though more than 2,000 students attend "in-residence" courses at DSMC each year, there are many others who need, but have been unable to get, the specialized education the College offers. To meet the need for regional courses, DSMC has established four permanent regional centers. Huntsville, Ala., and Los Angeles, Calif., centers offered their first courses in 1984. A third center opened in St. Louis, Mo., in December 1984. The fourth center opened in Boston in mid-'85.

Selected DSMC short courses are offered at the regional centers. These include:

—Program Management Course, Part I
—Contract Finance for Program Managers Course
—Contract Management for Program Managers Course
—Contractor Performance Measurement Course
—Fundamentals of Systems Acquisition Management Course
—Management of Acquisition Logistics Course
—Multinational Program Management Course
—Systems Acquisition Funds Management Course
—Systems Engineering Management Course
—Test and Evaluation Management Course

The regional centers also serve as consultants to their "host" organizations and provide valuable experienced program management advice on all phases of the weapons systems acquisition life cycle.

Program Management Course

The Program Management Course (PMC) is a 20-week course divided into two parts. The first 6 weeks of PMC, Part I, provides a knowledge-based foundation of system acquisition for use in Part II of PMC. The last 14 weeks of PMC, Part II, provide additional knowledge and the opportunity to apply the knowledge gained in Part I and Part II during experiential exercises and simulations based on the DOD weapon system acquisition process. To enter Part II, the student must have successfully completed PMC, Part I, or demonstrated an understanding of the fundamentals of DOD acquisition through experience and written examination. Most students will take PMC, Part I, immediately preceding PMC, Part II, and will be on the DSMC Fort Belvoir campus for the continuous 20-week period. A few students will have taken PMC Part I, in one of the regional centers and will be on campus for only the 14 weeks of PMC, Part II. In the future, to better support DOD military and civilian career goals, a greater percentage of PMC students will take Part I early in their acquisition careers and will take the 14-week Part II after several years of acquisition experience.

The following discussion of the PMC is divided into two parts: the objectives and sequence of instruction within the 14-week Part II and the functional disciplines woven throughout PMC, Part I and Part II. The short course section contains a complete description, objectives, and content of PMC, Part I.

Program Management Course, Part II

The PMC, Part II, is centered around an adventure-based simulation divided into the phases of a weapon system life cycle and designed to provide the student with the knowledge, skills, and leadership necessary for successful weapon systems acquisition. While Part I of PMC is primarily aimed at increasing student knowledge of DOD acquisition management disciplines, the primary objective of PMC, Part II, is to increase student understanding of how to integrate those disciplines in a real-world setting with a strong emphasis on the leadership abilities necessary to ensure successful weapon systems acquisition. The curricula helps prepare the student for the challenges inherent in senior leadership positions of major weapon system acquisition projects through topical discussion of management and leadership skills as well as individual and group exercises. The individual and group exercises give the students the opportunity to practice the leadership and management techniques discussed in class. Students obtain maximum value from participating in PMC program office simulations through the use of adult education principles and techniques which enhance the effectiveness of their self-directed learning.

Individual Learning Plans

The PMC students are provided an opportunity to tailor a portion of the curricula to their individual learning needs. A competency assessment instrument helps identify gaps between their present acquisition skill levels and the ones needed for their unique positions upon graduation. After identifying their learning needs, they write a plan to acquire those competencies in their preferred learning styles—library research, interviews, computer modules, group projects, formal elective classes. Faculty advisors assist in the development and execution of the plans through counseling and identifying available learning resources. This program is supported with scheduled elective courses.

Industry Program

This is a program designed to complement classroom learning by allowing students to participate in an actual acquisition program and

thereby experience challenges confronting both the DOD program manager and the defense industry counterpart. Interest areas and relevant questions are drafted in preparation for a field trip to the contractor's plant. There, the interaction between industry employees and students fosters an understanding of production requirements, management issues, and a realization of the vital role a company plays in the fielding of a major weapon system.

Capitol Hill Program

All students participate in a 3-day workshop on Capitol Hill with opportunities to visit one or more congressional committees, congressmen, and staff members responsible for legislation on national defense. The purpose of the Capitol Hill workshop is to develop a better understanding of the complex world of program management as seen from the eyes of the Congress.

The Functional Disciplines

Woven throughout the PMC are the functional disciplines of acquisition management. The PMC, Part I, introduces the functional elements of knowledge of each of these disciplines. The PMC, Part II, includes additional knowledge elements of each discipline which are then integrated into the life-cycle structured simulation of a DOD weapon system acquisition project. The functional disciplines are:

—DOD Acquisition Policy

—Explores the environment external to the program management office that provides authority for systems acquisition, and controls and constrains the acquisition management system at every level of decision-making; OSD through the Service headquarters to the program office. This includes DOD organizational and management interfaces and practices, the system life cycle, acquisition planning and acquisition strategy. A review of the role of the Congress in system acquisition is included.

—Principles of Program Management

—Addresses a variety of management topics. How program managers must staff and deal with basic program office structures is presented, as well as the impact of external organizations on the program manager. The block also develops appreciation for the industry program manager's responsibilities and associated corporate pressures, decentralized management; and an overview of the international and multiservice acquisition environment. Brief introductions to quantitative and nonquantitative problem-solving techniques are also provided. The principles of program planning and control with the goal of achieving program balance in the complex and dynamic defense acquisition environment are covered, as are several process and scheduling techniques, including Line of Balance. The capstone lesson is an integrative exercise where students apply the knowledge gained during Part I to develop an acquisition strategy and related program master schedule in a two-part case study.

—Managerial Development

—Offers strategies for effectively managing the internal organizational environment and for addressing situations created by the external environment. Begins by identifying the student's values, talents and preferences. Builds on a dual foundation: exploration of individual similarities and differences, and improvement of basic communications skills. The objective is to improve interpersonal relationships through better understanding and appreciation of how people differ. Builds knowledge of ethical standards of conduct and develops skills in distinguishing the ethically acceptable from that which is not. Deals with the improvement of leadership and managerial skills by addressing potential improvements in the student's ability to work with and through others.

—Systems Engineering Management

—Explains and integrates the fundamental concepts that are the bases for the definition, design, development, production, test, and logistics support processes. This conceptual framework is based upon a critical review of mission requirements and their translation into technical specifications for equipment, software, facilities, data, and trained personnel. The systems engineering process includes an iterative series of rational trade-offs among performance, life-cycle cost, risk, producibility, supportability, testability and engineering specialty requirements. Systems engineering management integrates and controls all aspects of the technical program and provides the framework to prioritize and balance conflicting requirements.

—*Cost/Schedule Control*

—Examines the use of cost/schedule control in program management. The instruction provides an understanding of the basic requirements in contractor performance measurement and methods for analyses of current status and estimation of final contract cost.

—*Contractor Financial Management*

—Highlights key issues and concepts of the defense industry contractor's financial management system. The emphasis is on understanding the financial motivations and constraints of the defense contractor. Subjects covered include financial and cost accounting, financial planning and analysis, working capital management, long-term financing, and capital investment with specific emphasis on areas unique to defense contractors.

—*Integrated Logistics Support Management*

—Emphasizes the need to identify the required support and to influence design in the early program phases, and to design and verify an integrated logistics support system concurrently with the development of the system hardware and software. A study of the critical elements of integrated logistics support (ILS) is made. Life-cycle cost is addressed with emphasis given to the need to make trade-off studies and decisions continually based on the life-cycle view of a system.

—*Test and Evaluation Management*

—Covers the role of development, operational, and production acceptance testing in reducing program risk. Addresses the purpose and content of the test and evaluation master plan and the role of the program office and independent test organizations in the initiation and conduct of test programs.

—*Manufacturing Management*

—Addresses productivity, producibility, industrial base, labor, and quality compliance considerations that affect planning and design efforts. Discusses production readiness reviews, templates for reducing risk in transition from research and development to production, and the general management of the production function. Government and industry viewpoints are considered.

—*Contract Management*

—Examines the contracting process from the program manager's perspective. Provides information on contracting policy and regulations in addition to emphasizing real-world interaction among the program manager, contracting officer and the contract administration office. Addresses all phases of the contracting process including acquisition planning, structuring contracts, solicitation, source selection, negotiation and administrating contracts.

—*Program Funds Management*

—Explains federal and DOD funding policies and processes. Includes financial management functions and responsibilities in cost estimating, budget formulation, review and execution. The Programming, Planning and Budgeting Systems (PPBS) and the Congressional Authorization/Appropriation Process are examined in some detail. Financial management accountability is addressed throughout.

—*Software Management*

—The software management portion of the PMC course provides participants with an understanding of the current policy, practices and procedures applicable to management of software acquisition for major defense systems. Software acquisition management issues involved in all phases of the defense systems life cycle are covered. Topics include, but are not limited to: software development cycle, software management principles, software metrics, contractual issues and considerations, software test and evaluation, and postdeployment software support.

Short Courses

—*Program Management Course, Part I*

—The PMC, Part I, has been designed as a 6-week course primarily for DOD personnel as a prerequisite to attending the 14-week PMC, Part II. The intended audience is: DOD military and civilian personnel and DOD industry personnel with several years of DOD acquisition experience, who are designated or highly-likely candidates for the 14-week PMC, Part II, or who are in career executive development programs in defense acquisition.

—The overall objective of PMC, Part I, is to introduce concepts, scope and application of program management within DOD, including technical management disciplines, business functions of the program office and principles of effective program management.

—The PMC, Part I, is designed to provide the student with: (1) an understanding of acquisition policies, tasks, problems, and issues confronting the program manager; (2) an understanding of the roles, activities, and integration of functions and relationships of government and industry organizations that participate in and affect the acquisition process; (3) an understanding of the importance of interpersonal relations and communication skills in the development of an effective acquisition team; (4) an enhancement of the ability of staff or functional managers to interface with program management office technical efforts through development of a better understanding of the technical management process; (5) an understanding of the activities and integration of technical disciplines necessary in the systems life cycle; (6) a basic understanding of funds management, contract management, and cost/schedule management; and (7) a familiarity of the business and technical practices of the defense contractors and their impact on successful systems acquisition.

—The PMC, Part I, consists of the following 12 modules:

- —The DOD Acquisition Policy and Environment (AP)
- —Principles of Program Management (PP)
- —Managerial Development (MD)
- —Contracts Management (CM)
- —Contractor Financial Management (CF)
- —Program Funds Management (FM)
- —Cost/Schedule Control (CS)
- —Systems Engineering (SE)
- —Software Management (SM)
- —Test and Evaluation Management (TE)
- —Manufacturing Management (MM)
- —Logistics Support Management (LS)

Advanced International Management Workshop

This is a workshop in international negotiation and international acquisition management. The overall objective of the workshop is to reinforce and advance the principles of collective defense through armament cooperation and to present a balanced viewpoint of attendant topics. The international negotiation segment will emphasize international Memoranda of Understanding and will include: preparation for negotiations; authority to negotiate; DOD policies and experiences; and other negotiation issues. The international acquisition management segment will cover key factors for the identification, design, implementation and management of a successful program; and, the role of the Congress in international acquisition.

The workshop is open to mid-level military officers, O-04 and above; civilian, GS-13 and above and industry equivalents. The workshop is targeted to those currently in, or entering positions of, responsibility in international or potentially international programs. As this is an advanced workshop, attendees should have a basic understanding of U.S. defense acquisition. Prior attendance to the Fundamentals of Systems Acquisition Management Course (FSAMC), Program Management Course, Part I, Multinational Program Management Course (MPMC), or equivalent international experience is strongly encouraged.

Contract Finance for Program Managers Course

American industry's role in the systems acquisition process is often decisive. Contract Finance for Program Managers is a comprehensive, 1-week course designed to furnish an overall understanding of defense contractor financial motivations and constraints, and an appreciation for how they affect management of a defense systems acquisition program. This includes the following:

—A discussion of the interrelationships among the contractor costing procedures and the financial and managerial accounting systems.

—An analysis of cost principles and indirect cost management in DOD contracts.

—The contractor's perspective on planning and control in business management.

—A discussion of the environment in which industry prepares and DOD personnel evaluate cost proposals.

Contract Management for Program Managers Course

This 1-week survey course is designed to provide an overall understanding of the systems acquisition contracting process from the planning ·· a solicitation through contract closeout. It concentrates on key activities required to award and administer a government contract. Included are

topics such as Program Manager/Contracting Officer relationships, acquisition planning, types of contracts, request for proposal preparation competition, source selection, modifications, award fee contracts, subcontract management and contract administration.

Contractor Performance Measurement Course

The 1-week Contractor Performance Measurement Course provides knowledge of how Cost/Schedule Control System Criteria (C/SCSC) are used in measuring contract performance on major weapon system acquisition contracts in DOD. The course enables the student to understand the criteria and their use in evaluating the adequacy of the contractor's management system, along with the contractual implementation of the criteria and the Cost Performance Report (CPR). Course instruction in analysis techniques enables the student to determine current status, forecast performance trends, and estimate contract cost at completion. The student is also introduced to contract performance measurement on less-than-major contracts through the application and contractual implementation of the Cost/Schedule Status Report (C/SSR). Instruction in financial reporting and baseline management helps the student to relate performance measurement data to DOD resource management.

Correspondence Course

Two self-paced versions of the Contractor Performance Measurement Course are also available. The standard self-paced version consists of workbooks and references. The computer-enhanced version adds interactive lessons and practice test question drills. These self-paced versions parallel the resident course but place emphasis on analytic skills which include the preparation of Estimates At Completion (EACs). Both versions include 10 study modules and a final examination. Most students require 30-35 hours to complete the courses. After successfully passing a written examination, the student will be awarded a Certificate of Completion.

Although there are no eligibility restrictions, an understanding of basic business management and statistics is recommended. The registration and distribution of course materials are coordinated by the Office of the Registrar.

Defense Manufacturing Management Course

The 1-week Defense Manufacturing Management Course was designed to provide an understanding of concepts and activities associated with manufacturing management and the transition from development to the production phase of the acquisition process. The course details, for program and functional managers, the basic principles to be followed in planning, organizing, integrating and measuring a production/manufacturing program. It follows a system life-cycle approach, stressing the necessary actions and activities to be accomplished during each phase of the weapon system acquisiton process. The issues, assumptions, and requirements that arise are addressed from the government and industry viewpoints.

Executive Management Course

—*Executive Level Course*

—This 3-week course is intended to serve senior individuals who are not graduates of the DSMC Program Management Course but whose current or imminent assignment is within the systems acquisition community.

—Topics that affect the systems acquisition environment now and in the future are integrated in the course design and context. The course provides participants with an understanding of the perspectives and positions of current key decisionmakers from the legislative and executive branches of government and the defense industry. Participants are offered the opportunity to interact directly with these individuals. Specific discussion is directed to the most recent legislative and executive actions affecting weapon systems acquisition. Attention is given to current DOD policy and procedural initiatives whose implementation is having a profound effect upon the acquisition environment.

Executive Refresher Course in Acquisition Management

—*Executive Level Course*

—The design and concept of this course includes topics affecting the systems acquisition environment now and in the future. The 2-week schedule is divided into two major sections—the Systems Acquisition Management Environment and Current

Initiatives. It provides an understanding of perspectives and positions of key decision-makers from the legislative and executive branches of government and the defense industry. There is the opportunity to interact with these individuals. Specific discussion is directed to recent legislative and executive actions affecting weapon systems acquisition. Attention is given to current DOD policy and procedural initiatives whose implementation has a profound effect upon the acquisition environment.

—The course is intended to serve individuals who are graduates of the DSMC Program Management Course and/or have significant experience in defense systems acquisition and are returning to, or continuing in, assignments within that community.

Fundamentals of System Acquisition Management Course

This course is a "quick look" at the Department of Defense systems acquisition process. It provides the student with a 1-week overview of the basics of system acquisition program management and the developmental life cycle of a weapon system from inception to retirement. Subjects cover weapon system concept exploration, development, production, and deployment. Discussions of mission area analysis, acronyms, terms, directives, policies and procedures, documentation and current issues are included.

Management of Acquisition Logistics Course

A 1-week Management of Acquisition Logistics Course provides participants with an understanding of Integrated Logistics Support (ILS) policy, requirements, and practices applicable to major and less-than-major system acquisition programs during the defense system life cycle. The course begins with a basic overview of the system life-cycle process and the system engineering process, and a fundamental discussion on the role that ILS plays in these two processes. It continues with lessons on ILS considerations and activities during the RDT&E phases of the system life cycle, during the transition to production, during fielding and deployment, and during the post-production (operation and support) phase. Other key topics include life cycle cost, reliability/maintainability/availability, logistics support analysis, logistics related test and evaluation, logistics modeling, and computer aided acquisition and logistics support. Guest government and industry lecturers discuss "real world" logistic issues and case studies offer the students opportunity to address and devise solutions for acquisition logistics challenges.

Management of Software Acquisition Course

The 1-week Management of Software Acquisition Course provides participants with an understanding of the current policy, practice, and procedures applicable to the management of software acquisition for major defense systems. Software acquisition management issues involved in all phases of the defense system life cycle are covered in detail. Overview of the defense systems acquisition process is included to provide the students with the proper basis for applying software acquisition principles. The course includes lectures, discussions and case studies on topics such as DOD computer resource policy and initiatives, software management principles, software cost estimating, software test and evaluation, software quality assurance, and software systems engineering. The software acquisition management principles are addressed from government and industry viewpoints by faculty and guest lecturers from government and industry. Special emphasis is placed on using "real-world" examples to illustrate management principles, issues and solutions.

Multinational Program Management Course

Designed for the student to develop an understanding of the competencies which one must process to effectively participate in an international defense acquisition program. Emphasis is placed on the U.S. policy of encouraging armaments cooperation and enhancing rationalization, standardization and interoperability (RSI) with our allies. Key National, Department of Defense and Service policies on international codevelopment, coproduction and logistics will be explored.

Senior Managers Total Quality Management Workshop

The Senior Managers Total Quality Management Workshop provides the latest technical and managerial concepts on total quality management (TQM). The DSMC faculty and guest speakers provide an understanding of TQM and its importance to DOD and the nation. The faculty and guest

speakers also work together with student groups to develop a TQM implementation plan to meet the needs of their commands and/or environment.

The 2-day workshop is held on the DSMC campus and other sites. Students are selected from among senior leaders in the Department of Defense. Prior to attending, students are provided with books and other subject material that will enhance their participation and work product they will develop.

Systems Acquisition for Contracting Personnel

This course is designed to provide the contracting professional with a fundamental knowledge and in-depth understanding of the systems acquisition environment from requirement definition to field deployment. All phases of a major system's life cycle are analyzed including defining the requirement, planning and budgeting for the requirement, technical performance and management of the requirement (test management, configuration management, quality control, ILS activities, software acquisition, statement of work and specification practices) and financing the requirement. Business management of the requirement includes knowledge of contractor estimating systems, financial statements and, most importantly, how a contractor actually prepares a cost proposal. Government management of a contractor's performance is examined by reviewing requirements for, and use of, cost/schedule control systems. Other topics such as warranties, types of contracts, source selection criteria and standards, price versus technical competition, and analyzing these areas in terms of their application in a major systems acquisition environment.

In accordance with DOD 5000.52, this course is mandatory for contracting series, GS 1102-13/14/15 and comparable military Level III personnel who are assigned to a major system or who spend 50 percent of their time supporting a major system(s). The course must be completed by contracting officers within 1 year of assignment to a major system. Although the course is desirable for Level II contracting series GS-1102-9/10/11/12 and comparable military who are assigned to a major system, priority will be given to personnel with mandatory requirements. Individuals in related positions from the defense industry are encouraged to attend.

Selected Acquisition Report Course

The Selected Acquisition Report (SAR) Course is designed to enable program office personnel and higher-level military service staff to prepare and review this important document prior to being submitted to the Congress. The SAR, as presented to the Congress, is the single summary public document that provides the status of the major Department of Defense acquisition programs.

This course provides students an understanding of the legislative background which generated the report requirement, as well as the relationship between the SAR and other program documentation. The course content is coordinated through the Department of Defense Comptroller, ODC(P/B)P/CM. Lecture/discussion classes cover the key information elements of the SAR and apply these concepts in a series of related case studies based upon a "generic" weapon system. Course offerings are scheduled primarily during the first quarter of the fiscal year to best support preparation of the annual SAR submission required by the Congress. The course is instructed at the DSMC Campus, at DSMC Regions (Los Angeles, Calif., Boston, Mass., Huntsville, Ala.) and other selected sites.

Systems Acquisition Funds Management Course

During the 1-week Systems Acquisition Funds Management Course, the student is provided an understanding of how to formulate, defend, and execute a weapon system acquisition budget. The student is introduced to the knowledge and skills in funds management necessary for assumption of program office financial management and execution responsibility, with emphasis on the techniques the program manager and functional managers may use to identify, analyze, and resolve budget related issues. The course follows the total budget process from the viewpoint of the program manager. The fiscal cycle is traced through all levels of the Department of Defense, the Office of Management and Budget and the Congress. The course examines the DoD planning, programming, budgeting system, congressional authorization, appropriation process, and budget execution procedures.

Systems Acquisition Management for General/Flag Officers

—Executive Level Course

—This 4½-day course is intended to provide participants with an understanding of the perspectives and positions of current key decision-makers from the legislative and executive branches of government and the defense industry. Participants have the opportunity to interact directly with these key individuals. Specific discussion is directed to the most recent legislative and executive actions affecting weapon systems acquisition. Attention is given to current Department of Defense policy and procedural initiatives whose implementation is having a profound effect upon the acquisition environment.

Systems Engineering Management Course

Fundamental knowledge of the systems engineering process is a basic prerequisite to efficient management of every program requiring the development of new components or systems. Consequently, providing an introduction to the concepts, scope, and application of the systems engineering discipline to the DOD system life-cycle process is the goal of the new 1-week Systems Engineering Management Course.

Systems engineering activities are individually presented, followed by illustration of their iterative application to ensure complete and rational tradeoffs among performance, life-cycle costs, risk, producibility, supportability, testability, and engineering specialty requirements.

Technical Managers Advanced Workshop

The Technical Managers Advanced Workshop (TMAW) brings together in a round table seminar, a group of senior technical managers (by invitation only) and DSMC faculty. Together, this group will discuss current acquisition problems and explore, identify, and evaluate potential solutions.

The 1-week class is held on DSMC's campus and at other facilities as appropriate. Students are selected from among senior DOD technical management personnel.

Workshops will define problem boundaries, and propose and develop problem solutions within them. The most useful problem solutions will be published as TMAW reports.

Test and Evaluation Management Course

Test and evaluation is the discipline that measures attainment of performance objectives for the purpose of reducing risk. The 1-week Test and Evaluation Management Course provides an introduction to the concepts, scope, and application of test and evaluation as a management tool for system acquisition executives. Areas of coverage include test and evaluation as the feedback mechanism for system's engineering, the relationship of test and evaluation to all phases of system life cycle, and the special relationship of test and evaluation to interfacing disciplines of hardware, software, production, affordability and logistics support.

Total Quality Management Course

—New Course Offered In 1989

—This 1-week course addresses theory and application of total quality management (TQM) principles in the DOD environment. An interdisciplinary course, it covers current DOD initiatives and their impacts in technical, financial, and acquisition policy. Selected guest lecturers from government, the defense industry and commercial industry will discuss TQM applications and problems unique to the DOD. Case studies allow the student to analyze and provide solutions to current problems facing DOD and industry program managers. Study objectives, assigned readings and functional lectures guide the students, who are encouraged to present actual problems for class discussion and analysis.

X. RESEARCH PROGRAM

Since its inception in 1976, the College's program of acquisition management research has grown steadily in scope and quality.

The research program has produced a series of guidebooks that have been integrated into the College curricula and made available for use throughout the acquisition community. Among those currently available are:

- Program Management
  - *The Program Manager's Notebook*
  - *Evolutionary Acquisition - Joint Logistics Commanders Guidance*
  - *Acquisition Strategy Guide*
  - *Joint Logistics Commander's Guide for the Management of Joint Service Programs*

- *Guide to the Management of Multinational Programs*
  - *Guide on Congressional Involvement and Relations*
  - *Scheduling Guide for Program Managers*
  - *Skill in Communication*, a vital element in effective management
- Technical Management
  - *System Engineering Management Guide*
  - *Manufacturing Management Handbook*
  - *Integrated Logistics Support Management Guide*
  - *Risk Management Guide*
  - *Test and Evaluation Management Guide*
- Business and Financial Management
  - *Establishing Competitive Production Sources*
  - *Strategies for Dealing with the Defense Budget*
  - *Contract Appraisal System (CAPPS) - Software Program*
  - *A Program Office Guide to Technology Transfer*
  - *Subcontracting Management*

The Research Fellowship Program for military personnel provides an educational experience in business and systems acquisition management. The program includes a 3-month tour attending an executive education program at a major university and the remaining time at the Defense Systems Management College performing research. This program provides additional resources for ongoing DOD efforts toward improvement of defense systems acquisition management.

The College has a Summer Faculty Research Program for distinguished military and civilian faculty members from government teaching institutions like the Service academics and others. The summer research program, from May to September, is tailored to the individual researcher in terms of interest and availability.

XI. CONSULTANT SERVICES

The faculty and staff at DSMC perform a variety of consulting activities ancillary to the teaching and research mission. Members of the faculty and staff are available to DOD agencies for short-term *ad hoc* consulting projects. The DSMC department directors determine the suitability of consulting projects on a case-by-case basis. Criteria for undertaking consulting projects include the transfer of current information in the DSMC curricula, compatibility of a proposed effort with the College mission, and the time availability of faculty and staff members.

FACT SHEET
PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Policy and Organization Management Department
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I. TITLE

Conflict Management

II. REFERENCES

—Stoner, James A.F., Management, 2nd Edition, 1982, Prentice-Hall, Inc., Englewood Cliffs, N.J.

—Beck, Dale and Barth, J.R., Proceedings, Eighth Annual Project Management Institute Seminar/Symposium, Montreal, Canada, October 6-8, 1976

III. POINTS OF CONTACT

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IV. PURPOSE AND SCOPE

This fact sheet is designed to:
—Explain the impact of conflict on program office effectiveness
—Identify sources of program office conflict
—Describe conflict resolution strategies
—Review management initiatives that reduce conflict.

V. DOD POLICY

—No specific DOD policy applies; however, manager development authorities generally agree that a manager who effectively manages interpersonal conflict enhances the productivity of his organization.

VI. CONFLICT AND PROGRAM OFFICE EFFECTIVENESS

Conflict is a disagreement of two or more parties arising from the need to share resources or from having different status, goals, values, or perceptions. Depending on its intensity, the conflict can vary from a difference of opinion between two individuals to a defiant feud among different factions of an organization.

Competition a contributing factor to improved organizational efficiency, may contribute to organizational conflict when the parties involved not only strive to attain their own goals, but interfere with others' pursuits of their goals.

Conflict is not necessarily detrimental to the accomplishment of organizational goals. Depending on the way conflict is handled, it can be constructive. It can provide new ideas, approaches, and effective solutions to problems. However, if conflict is not handled properly and if it is allowed to drift unchecked, it can be destructive with results that are counter-productive to the organization's effectiveness.

Destructive conflict may cause poor program decision-making, lengthy delays over minor issues, and an overall deterioration in the team's cohesiveness and work effort. Feelings of defeat, tunnel vision, distrust, and an increase in psychological distance among people often occur.

The program manager's challenge is to change conflict into cooperation where team members work together toward mutual goal achievement and program success.

VII. SOURCES OF PROGRAM OFFICE CONFLICT

Conflict is prevalent in the work environment of the program manager because of the many diverse departments with which he must interact. The program manager is responsible for directing the program team toward achievement of program goals; however, his matrix team members often have responsibilities not only to the program, but also to their functional departments. The effectiveness of the program manager in channeling constructive conflict to improve his program's results and in resolving dysfunctional conflict will determine, in large degree, ultimate program success. Specific sources of conflict in which the Program Manager may be involved, or that may require his intervention, are as follows:

—*Lack of Clear Objectives.* One of the most frequent and serious sources of conflict is not understanding program objectives. The responsibility for determining objectives clearly rests with the program manager, based on input from management and the rest of the organization. If the program team members or others in the organization do not understand the program objectives, conflict can result as people pull in different directions.

—*Lack of Understanding or Agreement with Objectives.* The objectives may be clearly stated by the program manager, but they may not be perceived accurately by the program team members; or even worse, the program team members may not be in agreement with them. Conflict results when team members try to achieve different objectives for the same project. The program manager must reconcile the situation by reviewing and "selling" objectives to team members and communicating them to the rest of the organization.

—*Program Priorities and Schedule.* Program team members may differ on the sequence of important activities and tasks necessary to achieve successful project completion. The program manager must be alert to disagreements that develop around the timing, sequencing, and scheduling of project-related tasks.

—*Personnel Diversity.* The program manager deals with a variety of people on the program team whose backgrounds, preferences, and objectives may differ widely. How well the program manager communicates his goals and management approach can affect the degree of conflict that develops and ultimate program success.

—*Individuals Who Seem to "Live" in Conflict.* Some people demonstrate a low-conflict avoidance behavior. They provoke arguments and exhibit confrontation behavior. The program manager should recognize such behavior and minimize the conflict these individuals cause with people on or off the program team. It is difficult to change individuals with low-conflict avoidance behavior, but an awareness that they create conflict prepares the program manager for his responsibility to resolve it.

—*Personal Power Plays or Politics.* Just as the program manager must be aware that some people seem to "live" in conflict, he also must be aware that some people pull power plays and that politics is a part of some organizations. Political goals are often in conflict with project and organizational goals. Although difficult for a program manager to manage, he must be aware that they are occasionally a source of conflict in a program.

—*Technical Opinions and Performance Tradeoffs.* The program manager must anticipate the conflicts that arise from diverse professional expertise when functional specialists defend their own profession or functional office points-of-view. Disagreements may arise about technical issues and tradeoffs, required performance specifications, and the means to achieve acceptable performance.

—*Line vs. Program Organization.* There is an inherent conflict among needs and goals of the functional organization and those of the program organization. This is an especially common source of conflict for the program manager in matrix organization. The program manager's understanding of the goals of functional departments and his ability to communicate program priorities to functional departments provide a base for resolving this source of conflict.

—*Resource Allocations.* No program manager, or organization for that matter, has an unlimited amount of resources (funds, manpower, facilities, etc.) with which to accomplish all activities or tasks that appear to be worthwhile. Quite often, a number of program and functional managers must share resources that are available, thereby leading to competition for resources and possible conflict.

—*The Program Manager's Lack of Authority.* Where the program manager fits into the overall organizational structure will determine his relatively high- or low-level formal authority. Although he may not rely on it heavily, a program manager who reports at a high level in the organization can use this leverage effectively to get results. Lack of authority makes conflict resolution more difficult since the program manager must communicate his ideas up the organization hierarchy in order to bring about results.

—*Misuse of Authority.* When going beyond the limits of his personal authority, the program manager develops his own conflict. Misuse of authority may be overt or covert, and tends to undermine the program manager's long-term success.

—*Lack of Information.* If program team members do not possess the necessary information to complete the activities for which they are responsible, they cannot be expected to deliver results. If they are pressured for results, conflict erupts. The degree of personal organization the program manager exhibits and his thoroughness in providing information can alleviate this source of conflict.

—*Misinformation.* Even worse than lack of information is misinformation provided by the program manager. It can result either through the program manager's careless communication, or through misinterpretation of information on the part of team members. When this source of conflict appears, the program manager can redirect the team by providing accurate information. Since communication is a two-way street, the program manager should require team members to provide feedback pertaining to program status. The program manager should be aware of the possibility of being supplied misleading information.

—*Role Ambiguity.* Program team members' clear understanding of their own responsibilities and roles can minimize conflict. However, overlapping or confused responsibilities (ambiguity) results in conflict. The program manager must communicate the roles that he and each team member will play in the program. Closely related is task conflict, which pertains directly to the content of the program activities in such areas as priorities, costs, resources, and timing. The program manager relies heavily on program team members to provide information to resolve this source of conflict.

Resistance to Change. The program manager has been called a catalyst to change. Conflict results from those persons in departments who perceive threats to their authority and tradition. The program manager must be conscious that any change, no matter how innocuous it may appear to be, can be resisted heavily.

VIII. CONFLICT RESOLUTION STRATEGIES

The four basic conflict resolution strategies available to the program manager are avoiding, forcing, compromising, and collaborating. These methods differ in the extent to which they yield effective results. They also differ in the extent to which they leave parties in conflict able to deal effectively with future conflict situations.

The appropriateness of each stategy depends on the factors in a given situation such as the specifics of the problem, intensity of the conflict, time available to reach a decision, relationship among the parties in conflict, etc. In general, if the first strategy used fails to resolve the conflict, another approach should be employed without delay in order to preclude the build-up of concurrent unresolved conflicts.

—*Avoiding.* This means withdrawing from the conflict issue. The manager chooses not to deal with the disagreement. In some cases the manager may elect to use the avoiding mode to allow the other party to cool off, or to buy time so that the issue can receive further study. If the issue is minor as viewed by the other party, the conflict may go away by itself. If it is seen to be a major issue, the conflict may intensify. When others are in conflict, the manager may choose to avoid getting involved hoping that they will resolve the problem without his intervention. Whether personally involved or not, the manager may elect to "smooth over" the problem area and focus instead on areas of agreement to reduce the intensity of the disagreement.

—*Forcing.* This means using one's power or domination over another to resolve the conflict issue. The manager chooses to rely on his superior position or influence to extract or direct a solution to his liking. This approach is characterized by competitive "I win, you lose" behavior that may be effective in the short run when time is of the

essence. Forcing is often used as a last resort because it tends to cause resentment in others and long-run deterioration of the work climate.

—*Compromising.* This means bargaining and searching for solutions that bring some degree of satisfaction to each party. Compromising yields less than optimum results as viewed by the parties involved since no side achieves its full objectives. If compromising is used most of the time, people learn to present their positions in an exaggerated fashion. Compromising may be effective if decisions can be made quickly that attain the organization's goals. If goals are not attained because "lowest common denominator" solutions occur, other modes of conflict resolution may be more effective.

—*Collaboration.* This meams finding an integrative solution. The conflict issue is clarified, studied, and even redefined in an effort to give each party a goal and solution that can be fully supported. Collaboration includes such approaches as joint problem-solving, consensus-seeking, and establishment of superordinate goals (higher-level goals on which all can agree) in order to achieve full cooperation. The major advantage of collaboration is that all parties may be very satisfied with the way the conflict was resolved. A disadvantage is that collaboration is likely to be more time-consuming than other approaches.

Specific steps a program manager may follow in an organized approach to assist others involved in conflict is to determine:

—*What Are We Trying to Accomplish?* What is the objective? Sometimes the program manager can lose sight of the objective if he becomes personally involved in a conflict issue. So, the program manager needs to remind persons in conflict what the program team is to accomplish.

—*Who Is in Conflict?* The program manager needs to identify persons involved in the conflict. Sometimes conflict is under the surface. If team members do not allow the conflict to surface, it may become uncontrollable. The program manager should be sensitive to these situations and recognize who is involved in conflict.

—*Who Can Resolve It?* Who has the information needed to assist in resolving the conflict? It may not be the conflict participants. Maybe the program manager needs to obtain or provide additional information.

—*Is All the Information Available.* Do persons involved in the conflict have a different amount of information? The program manager may need to assure the exchange of necessary information.

Recommended actions also include:

—*Depersonalize the Conflict.* The program manager should see to it that personal attributes are not criticized, but that the work or issue is discussed.

—*Search for Agreement.* The program manager should listen carefully to persons involved in the conflict and search for possible areas of agreement among conflict participants.

—*Build on areas of agreement.* The program manager should strive to integrate areas of agreement in a manner that leads to support for the overall solution to the conflict.

IX. MANAGEMENT INITIATIVES THAT REDUCE CONFLICT

The responsibility for preventing and resolving conflict lies with everyone involved, but the consequences of the conflict affect the program manager the most. Destructive conflict must be minimized for program success.

Reducing the number and intensity of conflicts is preferable to resolving them. The following management initiatives are recommended as a comprehensive approach to establishing an organizational climate likely to minimize undesired conflict. When used together, these initiatives should also improve the general level of program office effectiveness and productivity.

—*Improve Communications and Coordination.* The free and unbiased flow of relevant information is essential to accomplishing all the other management initiatives. Guidance, decisions, technical opinions, etc., whether transmitted verbally or in writing, must be clear, accurate, and disseminated in a timely manner to those in need of the information. Required coordination of higher headquarters, program manager, the matrix team, and other supporting elements needs to be clearly established and implemented efficiently. This will ensure that incomplete or inaccurate information does not cause unnecessary conflict and poor decisions to be made.

—*Clarify Objectives, Priorities and Responsibilities.* Goals and objectives should be agreed upon, clearly

promulgated in writing and verbally, and referred to at major decision points to ensure that effort and resources are focused uniformly toward program accomplishment. When program change is warranted, program team members must be fully briefed and their efforts appropriately redirected to maintain full support for the program.

As a program proceeds, task and resource use priorities need to be established and changed as required to keep the program on schedule. The manager should determine his short-and long-term priorities and keep his program team fully informed of priorities and his reasons for them.

Task responsibilities should be clearly defined, and adequate authority given to staff members in connection with their respective responsibilities. All members of the program team should know how their efforts are being integrated into the program strategy.

—*Improve Leadership and Use of Authority.* A program manager able to work effectively with and through subordinates, peers, and superiors is more likely to maintain support for his program. The manager who develops his leadership skills and enhances his formal and personal authority is able to persuade others crucial to the success of his program to follow his guidance.

A program manager establishes a productive work environment when he sets a personal example of the behavior he believes to be necessary for program success, develops and motivates others to support his initiatives, delegates significant responsibility, and rewards desired performance.

—***Improve Relations, Build the Team.*** The knowledge and acceptance that people are different in personality, experience and preferences can help the program manager manage his team more effectively. By working to create a climate of mutual, professional respect among all team members, and by granting greater opportunity for individual participation and recognition, the manager encourages interpersonal cooperation.

—*Encourage Individual Initiative and Flexibility.* Management of high technology programs often occurs in complex organizations staffed with diverse functional specialists. The program manager seeks to obtain needed expertise and support for his program, but needs to exercise his responsibility to accept or reject the very inputs he has requested. To achieve a quality product, functional specialists on the program team must be challenged to provide their best efforts with the understanding, however, that some of their contributions may need to be changed or adjusted to meet specific program needs.

—*Manage Time and Other Resources Efficiently.* A common perception among program team members is that there is just too much to do in too short a time with too few resources. While this is also true of the program manager's situation, it is still he to whom others look to provide a course of action that is reasonable and sustainable. The manager who allocates his time and that of others to established priority efforts, and is willing to defer or eliminate non-essential activities, reduces organizational stress and improves office effectiveness. When he also allocates the use of other resources such as manpower, funding, facilities, etc., based on the same priorities, the overall efficiency of the office is enhanced.

FACT SHEET PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Policy and Organization Management Department

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I. TITLE

Evolutionary Acquisition (EA) of Command and Control (C^2) Systems

II. REFERENCES

—Office of Management and Budget Circular A-109, "Major System Acquisition"

—DODD 5000.1, "Major and Non-Major Defense Acquisition Programs"

—DODI 5000.2, "Defense Acquisition Program Procedures"

—Defense Acquisition Circular (DAC) 76-43, "Acquisition Management and System Design Principles," February 28, 1983

—Joint Logistics Commanders Guidance for the Use of an Evolutionary Acquisition (EA) Strategy in Acquiring Command and Control (C^2) Systems," March 1987

III. POINTS OF CONTACT:

Service headquarters/major command acquisition policy directorates.

IV. PURPOSE AND SCOPE

This fact sheet is designed to:
—Foster understanding of EA.
—Encourage consideration of EA as an alternative acquisition approach to acquiring C^2 systems as well as other systems.

V. OSD POLICY

Evolutionary acquisition is an alternative to the acquisition process normally used to acquire selected command and control systems. Its genesis is found within the principles of flexibility and innovativeness stated and implied by policies promulgated by the Office of Management and Budget as well as the Office of the Secretary of Defense (OSD).

VI. JOINT LOGISTICS COMMANDERS POLICY

The policy of the Office of the Secretary of Defense makes available the use of evolutionary acquisition for systems whose capabilities are to be introduced incrementally; the Joint Logistics Commanders endorse this OSD guidance. Successful use of evolutionary acquisition requires modifications to the practices of systems acquisition. Particularly important are relationships among the acquisition executive, the user, the surrogate user, the independent tester, the supporter and the developer; all of whom must be of high quality for evolutionary acquisition developments' successful performance. *The Joint Logistics Commanders will, as necessary, assist subordinate commanders and their program managers in negotiating any special arrangements which might be required to successfully implement evolutionary acquisition.*

VII. WHY EVOLUTIONARY ACQUISITION FOR C^2SYSTEMS

The use of conventional approaches to acquisition of large, software-dominated C^2 systems is intended to help operational commanders perform command and control functions. Often, this led to unsatisfactory results. Difficulties have arisen primarily because for Command and Control systems it is often not feasible to define in detail, before starting full-scale development, what the operational capabilities and functional characteristics of the entire system will be. If full-scale

development on a *total-system* basis of *any* system is undertaken without clear definition of operational concepts and capabilities and the functional characteristics the entire system is to have, then it is likely the development process will be long, costly, and unstable, and the system developed will be unsatisfactory.

In consideration of these difficulties, the use of Evolutionary Acquisition strategy in acquiring C^2 systems should be considered.

VIII. WHAT EVOLUTIONARY ACQUISITION IS

Evolutionary acquisition is an acquisition strategy which may be used to procure a system expected to evolve during development within an approved architectural framework to achieve an overall systems capability. An underlying factor in evolutionary acquisition is the need to field a well-defined core capability quickly in response to a validated requirement, while planning through an incremental upgrade program to eventually enhance the system to provide the overall system capability. These increments are treated as individual acquisitions, with their scope and content being the result of both continuous feedback from developing and independent testing agencies and the user (operating forces), supporting organizations, and the desired application of new technology balanced against the constraints of time, requirements, and cost.

Considered most broadly, EA consists of first defining the requirement and the general outline of the system; and then sequentially defining, funding, developing, testing, fielding, supporting, and evaluating increments of the system beginning with a core or baseline system, to be enhanced through incremental upgrades.

IX. WHAT EVOLUTIONARY ACQUISITION IS NOT

—An approach that provides for unconstrained requirements growth and an unbridled budget.

—A single strategy ready for application to all C^2 system acquisition efforts.

—A checklist approach that will greatly simplify C^2 acquisition.

—A free ticket to exemption from competition, disciplined configuration management, testing or integrated logistics support planning. (Evolutionary Acquisition poses additional challenges in these areas and requires careful trade-off analysis to reach smart decisions that will benefit the total acquisition.)

X. THE EVOLUTIONARY ACQUISITION MODEL

Figure 1 represents graphically an EA model and its application over time. The model emphasizes the incremental nature of the EA approach and the essential continual user involvement in every phase of development.

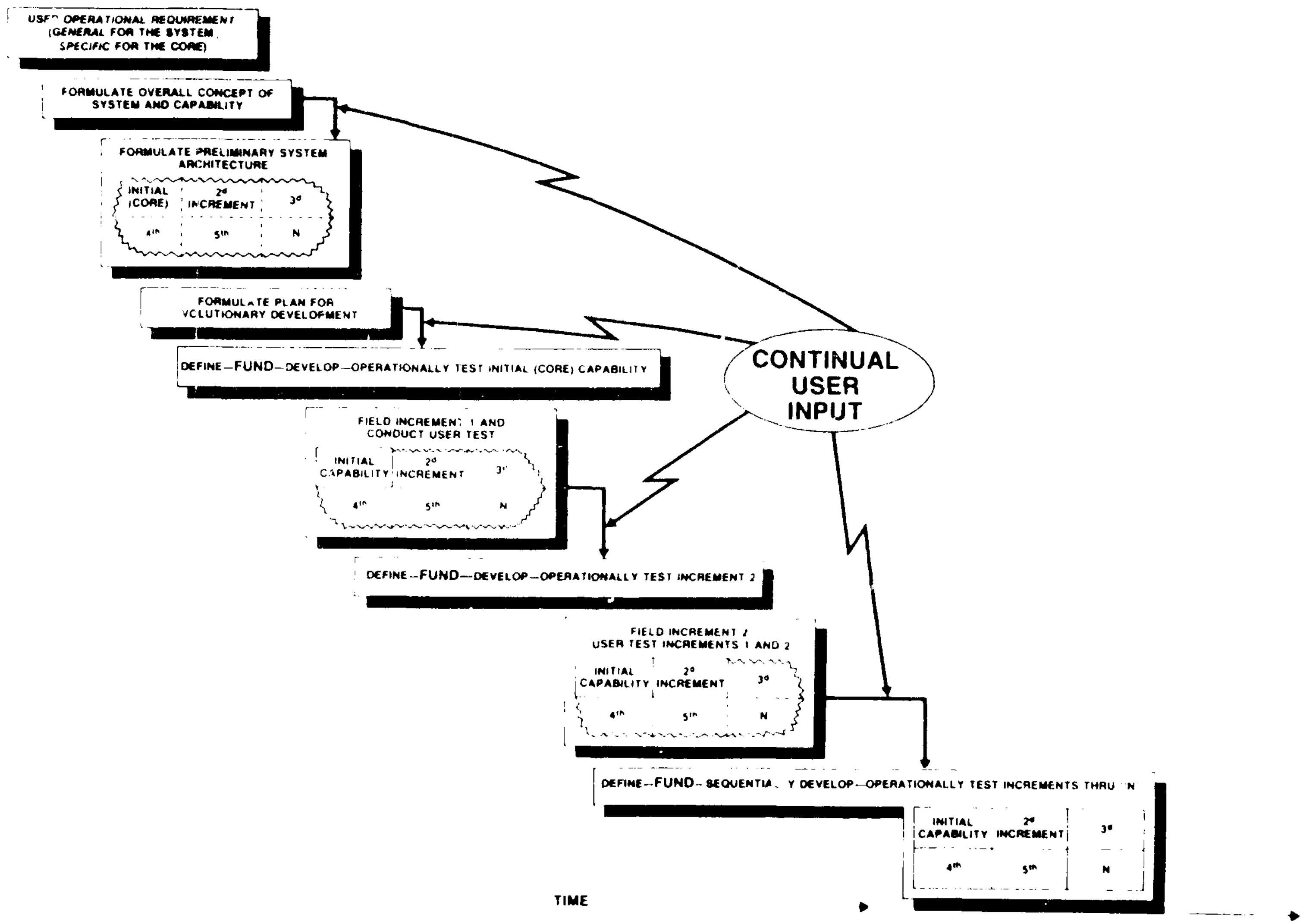
—The Service Chief or his representative begins the process when he defines the *overall system* operational concept and requirements in functional terms based upon user input. At about the same time, he also defines in considerable *detail* the operational concept and functional requirements for the *first system operational element* to be fielded (the core element). When fielded, the *core element* must provide a *significant, identifiable operational capability* and be supportable in its intended operational environment.

—After the Service Chief or his representative formulates an overall system concept and identifies the overall capability required in the final configuration, the developer recommends for service approval a systems architecture capable of accommodating system evolution with minimum system redesign. The supporter identifies those minimum elements required to sustain the system in its intended operational environment. The architecture is a critical element that should be structured with care and some detail, although a high degree of specificity as to details may be impossible at first.

—The evolutionary development plan is a Service-approved and funded product. Its goal is achievement of the overall capability through incremental development fielding and supporting of incremental upgrades to the "core," or baseline, operational capability.

—The Service Chief or representative, with continuing developer, supporter, and user input, defines the initial (core) capability to be developed, tested and fielded. Significantly, the core element is not fielded until operationally tested to determine its effectiveness, suitability, and sustainability. The fielded incremental capability is then operated and exercised by the user and sustained by the sup-

Figure 1. EA: INCREMENTALLY DEFINE, FUND, DEVELOP, FIELD, SUPPORT AND OPERATIONALLY TEST THE OPERATIONAL CAPABILITY TO SATISFY THE EVOLVING REQUIREMENT



porter in its operational environment, and the user provides recommendations to be addressed in definition of later incremental upgrades.

—On a (most-likely overlapping) sequential basis, the additional increments of capability are defined, service approved, developed, operationally evaluated, fielded, and supported in the same way as the initial increment.

As highlighted in Figure 1, funding for the system elements is also incremental in nature. Budget approval and funding for each element is made available only after the operational, performance characteristics and support requirements of that element have been defined in sufficient detail for development of that element to begin.

In the interest of simplicity, the model does not present the contribution that an off-line development, test and support facility may make to the development process. Such a facility, utilizing operational mockups, simulations and a software laboratory will generally be required for system development, for development testing, and for system integration. The facility will serve also to help integrate the user and tester input with the development activities, and will provide the capability to develop and evaluate hardware and software updates.

XI. AREAS REQUIRING SPECIAL CONSIDERATION WHEN USING EA

While evolutionary acquisition could be the best alternative approach to use in acquiring certain software dominant C^2 systems, EA of course is no panacea. To successfully formulate and execute an EA strategy, a number of areas must be given special consideration. Key areas requiring such consideration are discussed below.

The Acquisition Executive, User, Surrogate User, Supporter, Independent Tester and Developer. In conventional acquisition programs, relationships among these six entities sometimes may be rather formal, and negotiations among them may be conducted at arm's length. For EA to be successful, some of the roles of these entities may need to be redefined, and most of the relationships need to be closer and more cooperative than has been the norm. Five areas in which relations need to be carefully considered are as follows:

—*System operational capabilities.* In system acquisition, a surrogate user frequently has the primary role in specifying the desired operational requirements for the system, while the real user may be rather far removed from this process, depending upon service procedures. In using EA to acquire C^2 systems, a major premise is that the real user, working in a close, continual relationship with the developer and supporter, should have a major voice in formulating operational requirements and in defining detailed system characteristics once operational requirements have been defined. Thus, the traditional roles of the user and of the surrogate user may have to be redefined for a particular program, in accord with the needs of that program. The complexity of these relationships is likely to be even greater in cases where the real user is in a service different from that of the developer. A Memorandum of Understanding or Agreement is recommended in these instances.

—*Operational Test and Evaluation.* Each service has within its organization an independent tester who is responsible for all operational test and evaluation. A premise involved in using EA to acquire C^2 systems is that C^2 systems are tested, incrementally beginning with the core system, to determine whether the core system (or the core system plus incremental upgrades to that system) meets the operational requirement. The user, in operating the system is a critical part of the system while using it in an operational environment. The independent tester evaluates the operational effectiveness and operational suitability of the system in the upgrade status in which it is presented, and is likely to employ user forces to do so. Therefore, the user gains more extensive experience and makes recommendations for establishment of operational requirements for subsequent system increments. This process of evolution of requirements and the introduction of upgrades, distinguishes the evolutionary approach from the more classical weapon acquisition process. The independent tester is an important player in this process. It is imperative that he become involved early in the program development phase and maintain a direct and continuous liaison with the developer and user throughout the EA process, so that operational test and evaluation can proceed with maximum rapidity.

—*Test and Evaluation Planning.* Both the software-intensive nature of requirements and the evolutionary approach may affect conventional test planning and evaluation. In particular, there is likely to be greater concentration on contractor testing than government-conducted development testing. This should be addressed in the TEMP from the outset, with an objective of exploiting integrated testing without losing critical independence of contractor/developer/user views.

—*Developer-User Interaction.* In some conventional acquisition programs, the developer and the real user may have little interaction with each other during the course of the development. For successful use of EA to acquire C^2 systems, the developer, user, and supporter need to work more closely together, over a lengthy period of time.

—*Program Review and Approval.* In conventional acquisition, there are normally only a few times that the program manager needs to obtain approval of the acquisition executive to allow him to proceed with the program. Such approval is normally required at each of the major program milestones. However, associated with each such milestone (on a major program) the program manager may have to give 50-75 briefings over a period of a number of months. For an EA program, on the other hand, each increment of capability might require approval of the acquisition executive and, perhaps, at each of several stages of development. Under these circumstances, it would be necessary to greatly streamline the review and approval process. For example, in some instances involving a simple program where the final configuration can be defined in some detail, the total system might be validated as a single requirement and each increment treated as a "release" so long as the program remains within designated performance and dollar thresholds.

Program Management. Frequently for conventional programs, a program office is not established until Milestone I or later. Often the program office is not well-staffed with experienced people during the early phases of a program compared with later program phases.

In using EA, it is important that a capable program office be established very early in the program because 1) the acquisition strategy must be defined early, 2) roles and relationships of the various key players in the acquisition process (as discussed above) need to be negotiated early, and 3) the program sponsor will need program office support in defining the fundamental architecture and support structure underlying the entire system.

Another consideration involving the program office is that the office must generally be staffed more heavily to allow it to manage all phases of the acquisition cycle concurrently; because, with the use of EA, several increments may be under development at any one time, and these various increments may be at different stages of the acquisition cycle.

Competition in Contracting. Four closely related areas of work involved in evolutionary acquisition require special consideration relative to competition in contracting. These areas are 1) system architecture; 2) development and maintenance of the Off-Line Development, Test and Support Facility; 3) system configuration management, and 4) logistics support. These areas of work may continue not only throughout the evolutionary acquisition period, but most likely throughout the lifetime of the C^2 system, since it is likely that the system will continue to evolve to some extent throughout its lifetime.

It is important that continuity be maintained in each of the above four functional areas throughout the acquisition process and continue for the operational lifetime of the system. Thus, these function must be provided directly by the government; or, alternatively, the particular contractor(s) performing the functions must be retained for a number of years. Changing contractors in these areas at *infrequent* intervals might take place without *undue* impact on the program. However, *frequent* contractor changes *in these areas* would be *highly disruptive* to the program and it may be preferable that the government gear up to perform the function "in-house."

On the other hand, normal practices concerning competition most likely could be employed for the tasks of developing *each of the increments* of the system's operational capability. Here, the inefficiencies of new contractors learning the system may or may not offset the positive values of competition.

In keeping with the evolutionary acquisition approach, special emphasis should be placed on early development of an acquisition plan to ensure that procurement leadtime constraints are noted and addressed up front. The EA "fast march" will necessitate innovative contracting approaches and early planning would afford maximum opportunity to utilize effective competition practices. For example, a two-phase process might be used as shown below:

—The first phase would involve multiple awards with the resulting contracts addressing the core capability of the system. Potential teaming arrangements would be indicated. Conceptual segments and approaches to incremental upgrades would be discussed, and a system specification prepared. Demonstration models would be deliverables, where feasible.

—The second phase would involve selection of a contractor for a system engineering integration contract. This would still permit competition at the second tier for individual increments. This approach would tend to be time-intensive up front, but would pay off with a smoother transition in the second phase, and would provide much greater accountability and confidence in the adequacy of the final system capability.

Control and Stability of the Development Process. Although evolutionary acquisition is by definition evolutionary, it is important that it be partitioned into fairly distinct increments, and that once the development of a particular increment is well underway, changes in functional requirements pertaining to that increment be made only if the changes are very important. These points require strong emphasis because of a combination of several circumstances:

—A C^2 system is mostly made of software.

—The user, in the case of an EA program, most likely would continually be able to identify changes he/she would like to see made.

—Many people (including undoubtedly some users and some program management personnel) unfortunately and erroneously believe software changes are easy to make at any time, because "it's simply a matter of programming."

—In view of these last two circumstances, it might seem natural for the program management office frequently to want to explore with the development contractor the idea of making various "minor" software changes.

—Computer programmers are commonly very optimistic in assessing the impact of making "minor" software changes, particularly if the program management office seems interested in making the changes.

—In reality, such software changes made downstream in the development phase (of a given increment) are very expensive to make, and may lead to software "bugs" that might be very difficult to detect and correct. As a rule of thumb, adding a small, additional capability to the system by a software change downstream in the development cycle is about ten times as expensive as it would be to achieve the same result by incorporating the capability into the system beginning at the start of a particular increment. Experience has shown that lack of tight configuration control of software leads to difficulty in operational testing and later during in-service use, with greatly increased cost often resulting as well as a delay in user satisfaction.

—Any changes to the configuration need to be assessed from a supportability aspect.

Configuration Management, and Documentation of System Design. For any acquisition program, configuration management and full documentation of the design of the system are important, and the technical data package is the key to disciplined documentation. For an evolutionary acquisition program, possibly involving both an evolving architecture and a series of system increments, it is especially important that configuration management and system documentation be comprehensive and of high quality.

Production and Installation. In considering evolutionary acquisition of C^2 systems, attention is normally focused primarily upon architecture, requirements, development, integration and evaluation; with relatively little attention given to production and installation of the systems.

Relative to hardware, most of the issues concerning production and supportability of the hardware of C^2 systems are not greatly different from the issues concerning production of the hardware of many other types of systems. One notable dif-

ference in hardware installation, however, is seated in the fact that many large C^2 systems are few in number or even "one-of-a-kind."

Concerning software, once the development is complete, production and distribution consists primarily of copying digital data from one storage medium to another. Thus, the cost of producing and distributing software is significantly less than its development.

Installation of software (exclusive of software integration and test) is also generally a trivial process, involving primarily simply reading digital data from a magnetic tape or disk into a computer's internal memory. Installation includes testing to ensure it was installed correctly.

Thus, since most of the costs of C^2 typically are in software, and since the costs of production of software are negligible, it is appropriate that most of the attention in the acquisition of C^2 systems be given to requirements, architecture, development, evaluation, integration and support.

Software Maintenance and Control. Maintenance of hardware consists largely of actions to determine whether the hardware is functioning properly, actions to prevent wear-out of components, actions to correct for drift in the functional characteristics of components, and actions to repair or replace badly worn or failed components. While the extent of the need for maintenance and the ease with which maintenance can be performed are determined to a large extent by the design and manufacture of the hardware, maintenance itself is concerned primarily with the adjustment, repair and replacement of parts of the system which drift, wear out, burn out or break.

Even though the term "maintenance" is generally used in both cases, maintenance of hardware and maintenance of software are two radically different things. Software does not drift, wear out, burn out or break and, thus, requires no maintenance of the kind required for hardware. But, software does malfunction when combinations of options are used that were never tested. Testing does not find all the bugs. These operational malfunctions do require software maintenance and support.

Software maintenance, rather than involving maintenance in the hardware sense, is concerned with two quite different activities. These two activities are:

—Detecting, localizing and analyzing software bugs (design deficiencies remaining in the software) and then either correcting the bugs by changing the design of the software, or devising means to allow the system to operate adequately in spite of the bugs.

—Changing the existing functional characteristics of the system by modifying the design of the software, and adding additional functional capability to the system by designing and adding additional software.

Because software maintenance activities result in functional performance changes to the software, adequate configuration management procedures must be observed in the maintenance process, and systems documentation (technical data package) must be updated to reflect the program changes. This practice must be followed for each software increment or phase that is released for use.

For C^2 systems acquired by means of evolutionary acquisition, it seems almost axiomatic that the above software functions must be performed by the development community, rather than by the support community, during the full period of the acquisition. Indeed, this is mandatory if difficulty in operational test and evaluation is to be avoided. Moreover, even after completion of the basic acquisition cycle, C^2 systems are likely to undergo subsequent incremental changes to meet changing operational conditions and to incorporate significant new capabilities. Thus, it is likely that a software development capability and the Off-Line Development, Test and Support Facility would be maintained for the operational life of the C^2 system.

In view of the circumstances, the transition of software design, control, production and maintenance from the development community to the support community should be treated on a case-by-case basis for each major C^2 system. However, from the very beginning the developer must consider support alternatives in the operational environment and either modify designs to increase supportability or plan for the necessary support to be available. Early in the conceptual stage, these tradeoffs

should be assessed, to include consideration of diagnostics/prognostics, design for discard, while they are still feasible to achieve.

User Designed/Maintained Software. With the advent of low-cost computers, low-cost and easy-to-use high-level software (such as data base management systems) and expanding software literacy, it is to be expected that some users will wish to design and maintain their own individual "micro" C^2 systems, including designing/maintaining their own software. Such software might be designed to run on separate micro (or mini) computers, or on large machines available to the users.

While a do-it-yourself micro system might sometime be desirable, such a system can also be a source of difficulties.

Difficulties might arise due to (1) possible lack of integration of such a system within a larger C^2 framework, (2) possible lack of adequate system documentation, and (3) possible lack of adequate configuration management.

The better the acquisition community can meet the user's needs in a timely and adequate way, the less likely the users will be to act as their own system developers.

Product Assurance. Solid product assurance planning must link all aspects/phases of the system and be visible at decision milestones. Such planning should highlight the fact that, in an evolutionary approach, the developer's responsibility must extend through user/fielded verification, and may entail special maintenance or warranty provisions.

Integrated Logistic Support. As with conventional acquisition approaches, ILS is critical in evolutionary acquisition to ensure that design is influenced by support requirements and that support is available for operational sustainment. In the C^2 environment, supportability of the software and the equipment which operates the software is critical to the supportability of the overall weapon system.

FACT SHEET PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department
Number: 9.4
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I. TITLE

Non-Nuclear Aircraft Survivability

II. REFERENCES

—MIL-STD-2069, "Requirements for Aircraft Non-nuclear Survivability Program"

—MIL-STD-2089, "Aircraft Non-nuclear Survivability Terms"

—MIL-HDBK-336 "Survivability, Aircraft, Non-nuclear"

—AMC Survivability Management Plan, September 1986 (Published by US Army Survivability Management Office, AV 290-3160

—NAVAIRINST 3920.1, "Establishment of Naval Air Survivability Program," 28 May 1976

—MIL-HDBK-268(AS) (Navy), "Survivability Enhancement, Aircraft Conventional Weapon Threats, Design and Evaluation Guidelines"

—*Fundamentals of Aircraft Combat Survivability Analysis and Design*, Professor Robert E. Ball, AIAA, New York, N.Y., September 1985

—Air Force Regulation 80-38, "Management of the Air Force Survivability Program"

—MIL-STD-1799 (USAF), "Survivability, Aeronautical Systems For Combat Mission Effectiveness"

III. POINTS OF CONTACT

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SAF/AQ
Washington, D.C. 20330
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IV. DEFINITIONS

—Survivability. The degree to which an aircraft is able to avoid or withstand a man-made hostile environment without suffering an abortive impairment of its ability to accomplish its designated mission.

—Vulnerability. Characteristics of an aircraft which cause it to suffer a definite degradation as a result of having been subjected to the effects of a man-made hostile environment.

—Susceptibility. Combined characteristics of all factors that determine the probability of hit of an aircraft component, subsystem or system by a given threat mechanism.

—Threats. Elements of a man-made environment designed to reduce the ability of an aircraft to perform mission-related functions by inflicting damaging effects, forcing undesirable maneuvers or degrading system effectiveness. Non-nuclear threats to aircraft include:

—Kinetic Energy Weapons (KEW)
—Directed Energy Weapons (DEW)
—Chemical/Biological/Radiological (CBR)

V. THE SURVIVABILITY PROGRAM

Government

Management of survivability engineering must conform to the objectives of MIL-STD-499A, "Engineering Management." integration of survivability engineering into the life cycle of a typical aircraft (weapon system) program is shown in Figure 1.

Survivability is an essential element of mission effectiveness as defined in DOD Instruction 5000.2. The survivability requirement must be stated in the Operational Requirement (OR), or Required Operational Capability (ROC) along with the expected threat. The OR or ROC shall specifically address the survivability requirements which include the hardness to specified threats (e.g., 30mm projectiles, laser, etc.), and signature levels required for each system (visual, infrared, radar, acoustic, intentional and unintentional electromagnetic emissions, etc.). Quantifiable survivability operational criteria must be established early in the program to support trade-off/benefit analyses against other design goals (Figure 2).

Basic trade-off factors for survivability enhancement features include:

—Vulnerability
—Susceptibility
—Safety
—Maintainability
—Reliability
—Logistics
—Performance
—Cost
—Weight
—Schedule
—Operational effectiveness.

Significant survivability benefits can be achieved with minimal penalties if survivability requirements are defined early in the program. Trade-off studies select the most effective combinations. These should be reflected in the System Concept Paper (SCP) and Decisions Coordinating Paper (DCP).

Contractor

Implementation of the government's survivability program requires the contractor to carry out a survivability program in accordance with MIL-STD-2069 or MIL-STD-1799 (USAF).

The Contract Data Requirements List (CDRL-DD1423) must require the contractor to develop, propose, obtain government approval of, and implement a survivability program plan. The functional relationship with other program tasks and events shall be clearly shown and described. Each task in the plan shall be identified in the work breakdown structure so that traceability and monitoring of funding may be accomplished.

The survivability program plan shall identify required tasks. These tasks include, but are not limited to, the following:

—Mission-Area Analysis
—Failure Modes, Effects and Criticality Analysis (FMECA)
—Damage Mode, and Effects Analysis (DMEA)
—Vulnerability Assessments
—Live-Fire Tests
—Survivability Assessments
—Susceptibility Assessments
—System Cost Effectiveness Analysis
—Survivability Enhancement Trade-off Studies
—Combat Damage Repair Assessment
—Survivability Design and Engineering
—Susceptibility and Vulnerability Testing
—Test Plans/Reports.

VI. CONGRESSIONALLY-MANDATED LIVE FIRE TESTING

The Congress recently enacted legislation titled. "Testing of Certain Weapon Systems and Munitions." The law stipulates that *covered systems* be tested for survivability and specifies that major defense acquisition programs may not proceed beyond low rate initial production (LRIP) until Initial Operational Test and Evaluation (IOT&E) is completed. *The cost of conducting all required tests shall be paid from funds available for the system being tested.*

VII. SUMMARY

System survivability is a clearly quantifiable "Force Multiplier." Survivability is of primary interest to the Congress and all Office of the Secretary of Defense and Service acquisition executives. It is doubtful that any weapon system program will succeed without a strong survivability engineering plan.

Figure 1. SURVIVABILITY LIFE CYCLE

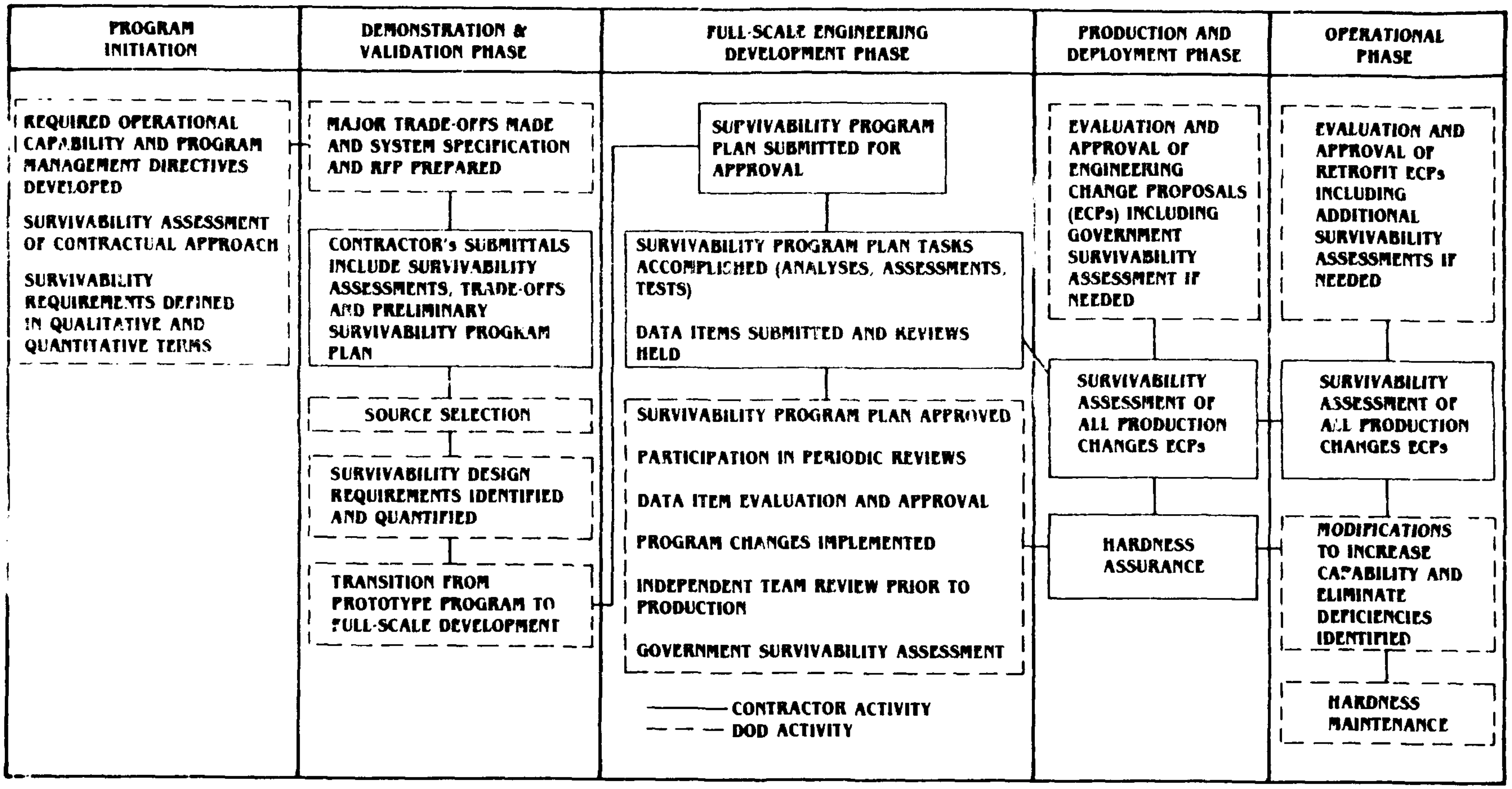
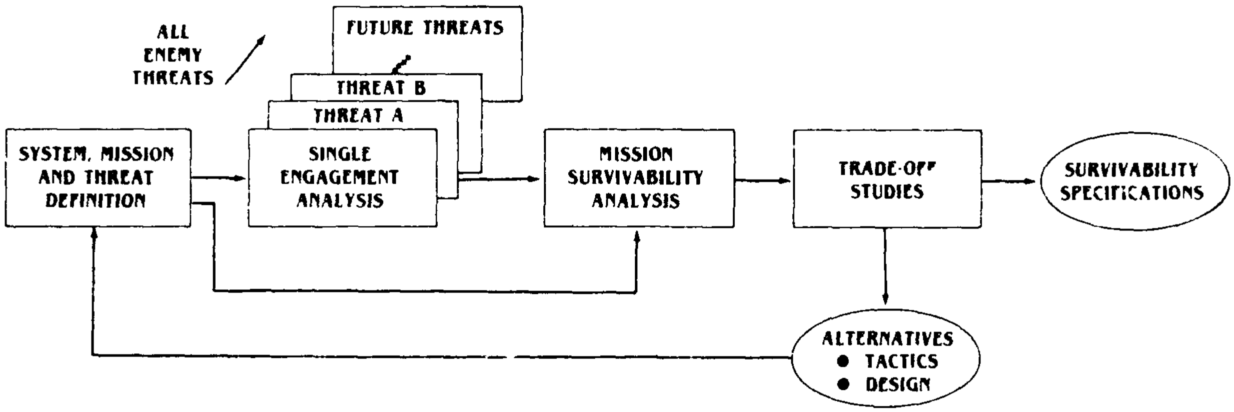


Figure 2. TOTAL SYSTEMS SURVIVABILITY ASSESSMENT METHODOLOGY



FACT SHEET PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

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I. TITLE

The Program Manager's Support System (PMSS)

II. REFERENCES

—PMSS Executive Overview and System Description
—DSMC Software Distribution Center Update

III. POINT OF CONTACT

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IV. PURPOSE AND SCOPE

This fact sheet is designed to inform the reader about the Program Manager's Support System.

Introduction:

—The Program Manager's Support System (PMSS) is an application of decision support systems technology to the defense acquisition program management environment.

—The purpose of the PMSS is to provide a management tool for managers in a program management office (PMO), to assist them in their decision-making process, and to help them execute their project more effectively and efficiently.

—The PMSS is intended to support the defense program manager and his/her first echelon staff; for example, the Chief Engineer, the Plans and Programs Officer, the Configuration Manager, the Integrated Logistics Support (ILS) Manager, etc. The PMSS also can be utilized by other managers in the acquisition community, for example, by headquarters level executives, program management officers in major projects, and field activity managers.

The PMSS will:

—Be an integrated software system operable on various hardware systems. The target hardware is low-cost microcomputers; e.g., the DOD standard Zenith Z-248. (The system also is being designed to run on minicomputers.)

—Provide a capability to: 1) integrate program management functional areas of responsibility, 2) generate program alternatives and impacts caused by various management actions and technical activities, 3) assess these impacts on the program's functional areas, and 4) utilize other decision-making support methodologies.

—Provide educational tools to facilitate the teaching of program management functions at educational institutions involved with defense systems acquisition program management.

The PMSS consists of two major parts, functional modules and the integrated PMSS. Functional modules are software programs that can be used as stand-alone programs to assist in program management areas of responsibility such as planning, acquisition strategy development, program management plan generation, cost estimating, scheduling, Program Objectives Memorandum (POM) development, budget generation, budget execution monitoring, financial management, systems engineering, production planning, integrated logistics support planning, test issues identification, Test and Evaluation Master Plan

(TEMP) generation, TEMP evaluation and monitoring, configuration management, document generation, document evaluation and monitoring, program office staffing and organization, etc. These modules support specific functions of program management operations.

The integrated PMSS consists of a number of integrated functions. The Program Overview function shows, in a color-coded (green, yellow, red) mode, the overall status of the program by the program hierarchical information categories. This provides the program manager an "instant" visual picture of his/her program status and quickly pinpoints program areas that require further management attention. The integrated PMSS, through the Program Impact Advisor function, will provide the capability for a program manager to tackle unstructured problems and address "What if....?" and "Should I....?" questions. This capability will integrate the functions of the functional modules so that a program manager can look across his/her entire program and address such questions as "What is the impact on my program if I get a 10 percent cut?" or "What is the impact on my program if the technology I need slips 6 months?" or "What is the impact on my program if there is a schedule delay?," etc. The integrated PMSS looks across and within all functional areas of responsibility to assess the impact on the program and helps the program manager develop alternatives for recovery.

The PMSS will also provide executive support aids such as a calendar; name, address and phone listings with dial-up capability; a tickler system; travel status reports and a briefing presentation aid. Support capabilities such as word processing, spreadsheets, data base management and decision tools can be added by the user, at his/her discretion.

The PMSS is *not* a management information system nor is it the decision-maker. It is a manager's tool to assist the program manager in his/her decision-making process. The PMSS will permit the integration of the user's experience, judgment and intuition to allow the user to evaluate available alternatives and, ultimately, aid the user to make better, more timely decisions.

The DSMC/PMSS Functional Modules In Distribution

Contract Appraisal System (CAPPS) module. The basic purpose of the CAPPS module is to facilitate the use of Contractor Performance Measurement (CPM) data for management decision-making. The CAPPS is a software program, with accompanying user documentation, designed to help managers keep abreast of, and quantify, project contract status information.

The CAPPS provides an analysis of Cost Performance Report (CPR) or Cost/Schedule Status Report (CSSR) data provided by contractors, readily accommodating any work breakdown structure or functional organization associated with a particular project. The module provides performance "exception" indicators, interpretations of the data presented, and automated trend analysis. The CAPPS makes maximum use of color and graphical presentations and has such features as zoom (to show more clearly the last 6 months of data) and full explanation screens. The CAPPS includes mathematical checks on new data, key elements based on lowest work breakdown structure element, and incorporation of actual data in the explain screens. In addition, monochrome and tabular data versions are included.

The CAPPS program is operational and available in two versions, one for the IBM PC/XT/AT, Zenith Z-248 and compatibles (Version 2.10), and one for Zenith Z-120 (Version 2.00). The IBM version will run on several compatibles but requires color graphics.

The *Cost Analysis Strategy Assessment (CASA)* module is a life cycle costing model that operates on microcomputers. The CASA was derived from Honeywell's Total Resource and Cost Evaluation (TRACE) family of Logistics and Life-Cycle Cost (LCC) Models. The TRACE models are used only on a mainframe computer.

The CASA module can be used for a number of tasks. They include LCC estimates, trade-off analyses, repair-level analyses, production rate and quantity analyses, warranty analyses, spares provisioning, resource projections (e.g., manpower, support equipment), risk and uncertainty analyses, cost driver sensitivity analyses, reliability growth analyses, operational availability analyses, and

spares optimization. With these capabilities, the CASA module can also be used in Design to Life Cycle Cost (DTLCC) studies.

The Air Force and Marine Corps have recently sponsored major enhancements to the CASA program including conversion from FORTRAN to C and a new user interface. The new CASA Version 2.00 will operate on IBM-PC/XT/AT, Zenith Z-248 and compatible microcomputers.

The computerized *Competition Evaluation Model (CEM)* is an analytical tool to help decision-makers determine the economics of using production competition. It compares the benefits with the costs of using a competitive production strategy. The model is a mechanism for keeping track of a large number of variables and assumptions, and for performing breakeven and sensitivity analysis on those variables.

This particular model uses standard progress curve theory as a starting point for analysis. The methodology on which the model is based assumes two changes occur to an initial producer's progress curve when competition is introduced. It assumes the first change to be a downward shift in the curve due to the initial producer's price reduction when competition is introduced. It assumes the second change to be a continuing steepening downward, or rotation, of the curve as the initial producer continues to reduce prices more than if competition had not been introduced. The model balances these positive assumptions against the expected cost of establishing production competition—the progress curve and rate penalties caused by splitting production between two or more sources.

The model is not a "crystal ball" for projecting any positive or negative aspects of production competition other than those that can be quantified. It is not a sophisticated tool for making precise statistical projections, because the existing data base on production competition is small and of uncertain validity. The model, however, provides a means to work around the data base problem by facilitating extensive sensitivity analysis. The model performs calculations based on numbers entered by you as the user. The model is operational and will run on the IBM PC/XT/AT, Zenith Z-248 and Zenith Z-120 series microcomputers.

Software Cost Estimating (SWCE) module: This module is based on a model originally developed for a Navy program management office. The original module, developed as a template on LOTUS 1-2-3, is an application of the Constructive Cost Model (COCOMO) developed by B. Boehm. The DSMC SWCE module, a modification of the Navy module, was developed as a template on Symphony to improve its user friendliness. The user can enter or modify several categories of lines of code and any of 14 cost drivers with results shown in terms of estimated effort in thousands of man-hours and estimated development time in months. Two versions are available, one without graphics, and one that graphs sensitivity curves of the cost drivers and comparisons of several user-developed "what if" data bases.

The SWCE module is in the prototype stage and is available. It requires Symphony Version 1.10 and should run on any system compatible with Symphony. The graphics version requires an Enhanced Graphics Adapter.

Government Activity Tasking (GAT) module can assist with the planning, budgeting and tracking of tasks assigned to government activities (as opposed to contracting) such as another service, laboratory, field activity, or another agency. Funding of such tasks is usually accomplished via a Military Interdepartmental Procurement Request (MIPR), Project Order (PO), or Work Request (WR). This module will allow correlation of tasks by funding citation, project, activity, or task.

The GAT is available, as a prototype module, and will run on an IBM-PC/XT/AT or Zenith Z-248.

The *Procurement Strategy Module (PSM)* is designed to assist acquisition management personnel in selecting a procurement strategy that can be pursued during each phase of a specific defense system's life cycle. For example, the module provides the user with an indication of the time and cost implications of pursuing a strategy of prototyping a complete system in the concept demonstration and validation phase as opposed to just building subsystems. Likewise, the time and cost implications of using multiple sources, versus a single source in the development phase, are addressed.

The user enters specific program parameters and the module compares these with a histori‿al data base of real program data to identify the most attractive strategies for the weapons system under development.

At the present time, the data base consists of only two categories of defense systems—tactical missiles and electronic subsystems. The opportunity exists to expand the data base for other types of systems. Military services and the acquisition community interested in expanding the data base into other categories (e.g., aircraft, tracked vehicles, ship systems, etc.) should contact the Director, DSS Directorate at DSMC.

The PSM operates on an IBM PC/XT and Zenith Z-120 series microcomputers and should run on most MS-DOS based microcomputers. The program is written in FORTRAN 77 and does not require color or graphics. The module is a prototype module.

Schedule Risk Assessment Management (SCRAM) module. This PMSS module will provide defense program management personnel with the capabilities of: 1) developing network schedules of their program activities, 2) performing schedule management functions (such as determining program status, identifying critical activities, developing work-arounds, etc.) and 3) conducting top-level schedule risk assessments. As a risk management tool, the module will provide estimates of the likelihood of achieving specified program milestones and will assist the manager in developing alternative plans that do meet program objectives. The module is intended for use directly by the manager within the program management office and will provide reports that directly support his/her decision-making.

Beta Test Version 3.00, a prototype module is available. The DSMC is not planning further development efforts on the SCRAM module as a stand-alone module. Most of the functions of SCRAM have been incorporated into the integrated PMSS. If anyone is interested in sponsoring further development/refinement of the stand-alone module, contact the Director, DSS Directorate, DSMC.

The *Executive Support System (ESS)* module is designed to assist managers with the day-to-day administrative type of functions such as keeping track of appointments and actions due. It contains a calendar function, action item status, telephone and address lists with automatic dialing, and travel status. It is designed specifically for government users.

The ESS is available as a prototype and will run on an IBM-PC/XT/AT or Zenith Z-248.

The Program Office Organization and Staffing (PROS) module is being developed to assist with organization and staffing functions which always seem to be time consuming. It is designed to allow easy development of the program management office's organization chart, to enter various attributes relative to the positions within the organization, and to keep track of on-board counts. Analyses of attributes, such as turnover rates or travel trends, and results presented either through highlighted organization charts or standard graphic charts are potential future enhancements.

This prototype module will run on an IBM-PC/XT/AT or Zenith Z-248. It requires a graphics card.

The PMSS Functional Modules In Development And Testing

The *QuikCost* module is designed to respond quickly to the budget question: "What is the impact if we cut your production rate from 500/year to 300/year?" The module shows quantity/rate relationships and the impacts of stretchouts and inflation changes. It should be used as strategies are considered for splitting buys or changing influences that will impact first unit cost and/or learning curves. It operates on the IBM-PC/XT/AT, Zenith Z-248, and compatible microcomputers and is a prototype module.

Expert Systems for Acquisition Strategies (ESAS)/Procurement Document Generator (PDG). The ESAS and its companion module the PDG, were funded by, and developed for, an Army activity that was concerned with non-developmental items (NDI) and non-major development support equipment. The ESAS module was tailored for that application and cannot be used by program management offices in other weapons systems areas. However, it can be provided for demonstration purposes. If a reviewing office is interested in having this module generalized for other applications, contact the Director, DSS Directorate, DSMC.

The ESAS is a software tool designed to assist project engineers or project managers in writing acquisition strategies. The ESAS allows for the rapid development of a clear, concise, and consistent acquisition strategy. The generated acquisition strategy will assist in preparing for review committees and in executing a successful procurement.

The ESAS engages the project engineer/manager in a dialogue, posing questions that must be addressed by an acquisition strategy. In all, more than 40 different topics are addressed. The questions were derived from applicable regulations, the Project Engineer's Guide, and knowledge gained through interviews with experts in the procurement process. Once the dialogue has been completed, the expert system can use the information provided by the engineer to produce a consistent acquisition strategy which can be viewed and edited on the computer's screen.

The system encourages an inexperienced project engineer to think about important issues that are often overlooked. The engineer can focus attention primarily on program issues, spending less time on the composition of a document. This allows time for extra attention to the program goals.

As an additional aid, ESAS provides expert recommendations about how to handle certain issues during the course of the dialogue.

The ESAS runs on an IBM XT/AT, Zenith Z-248 or compatibles.

The Procurement Document Generator (PDG) is a computerized system designed to assist managers in the development and maintenance of procurement documentation. The PDG may be executed in stand-alone mode or used in conjunction with the ESAS module. The PDG environment consists of a word processor for preparing and modifying documents; a context-sensitive help module, which is on-line at all times; plus data bases containing overview, help, explain, and sample text. An optional expert system interface is also included which is currently configured to support only the Expert System for Acquisition Strategics module. The PDG makes extensive use of windows, pull-down menus, and submenus to provide a clear and easy-to-use environment.

The PDG has the primary task of helping the user to write, update and otherwise maintain various procurement documents for program management personnel. The PDG is used to facilitate this process as much as possible. To this end, the PDG provides the tools needed to create and maintain the following plans:

—Acquisition Strategy (AS)
—Commerce Business Daily (CBD) notices
—Specification/Product Description (SPEC)
—Statement of Work (SOW)
—Contract Data Requirements List (CDRL)
—Source Selection Plan (SSP)

The PDG is designed to use on the IBM-XT/AT or Zenith Z-248 microcomputers or compatibles.

Parametric Cost Estimating (PACE). The objective of this module is to assist managers in a program management office to develop cost estimates for elements of a weapon system and the conduct of cost trade-off analyses. The user will be able to select a data base from a preloaded set for several categories of weapons systems or any other data base devised. Data base management functions such as input and change or delete will be available, and the user can manipulate the data for analysis, forecasting and graphics. After a cost estimate has been prepared, it can be passed to the Budget Preparation and Execution module through a compatible data file.

This module is designed to run on an IBM-PC/XT/AT, Zenith Z-248 and compatibles, and the Zenith Z-120.

Schedule and Resource Allocation (SARA) Module. The Army Institute for Research in Management Information and Communications/Computer Sciences (AIRMICS) developed an Automated Program Management System (APMS) for software development managers. The initial system operated on a minicomputer with a high-resolution color microcomputer as a front end. In conjunction with DSMC, the APMS project has been expanded to provide a resource allocation and program scheduling capability and has been programmed to operate on an IBM XT with a high-resolution color monitor and special color graphics board. This program has been renamed the SARA module which is a planning tool to assist managers in the initial development of, and subsequently making changes to, a program schedule and the allocation of resources. A schedule is entered, resource categories are

designated (up to 13 can be color coded), resource limitations are entered, and the program schedule is constructed in a Gantt Chart format. Resource totals are compared with limitations, category by category, and the schedule is revised, manually or by the computer as the user desires, until an optimum schedule is developed.

The SARA program for use on an IBM-XT has been prototyped, but is hardware-limited due to the special color graphics board that is required to provide the resolution necessary for maximum system usefulness. The AIRMICS, in conjunction with DSMC, is currently converting SARA from FORTRAN to the C language, and optimizing it for operation on the Zenith Z-248 microcomputer.

A version of SARA with reduced capabilities, is being developed to work on a Zenith Z-120 system.

Automated Program Planning and Documentation Module (APPDM): The objective of this module is to develop a generic software program to assist managers in a program management office with planning activities in all appropriate elements of a defense weapon system acquisition program, and then help create the requisite documentation associated with that element's planning activity. Documentation that can be created with this program include: a Program Management Plan (PMP), Production Strategy/Plan (PS/P), Test and Evaluation Master Plan (TEMP), Systems Engineering Management Plan (SEMP), Integrated Logistics Support Plan (ILSP), and Risk Analysis and Management Plan (RAMP). The software program will aid in developing the above documents in the following ways: 1) identify, describe, schedule and provide a means to track the progress of the activities that lead to the creation of these documents and 2) provide sample documents that combine with the user's program summary data to create draft documents. These draft documents can then be easily tailored to fit a particular program's needs.

This module will run on an IBM-PC/XT/AT or Zenith Z-248, and the Zenith Z-120.

Budget Preparation and Execution (BP&E) module provides a simulation and tracking tool to assist managers in a program management office with program budget formulation, monitoring, and decision-making. It has the capability to plan and prepare budgets, and to track the budget process and budget execution. It allows generation of a work breakdown structure and individual tasks, selection of appropriations and assignment of program element/line item numbers, assignment of performing activities, and the tying of these attributes together with cost estimates. The module contains the DOD appropriations, MILSTD-881A WBSs, a production cost function, escalation indices, and guidance and suggestions to assist with managing the budget process.

The BP&E provides the capability to view a program both from the WBS point of view and the budgetary/appropriation point of view. It also allows "What if?" exercises to assist with alternative planning and generation, and can compare obligation plans versus actuals. Various standard format reports are available.

The module is being developed to run on an IBM-PC/XT/AT, Zenith Z-248, and compatibles.

The *Venture Evaluation Review Techniques (VERT)* module is a computerized, stochastic network module designed to simulate decision environments under risk. The VERT provides the program manager with accurate risk information in all three risk parameters (time, cost, and performance) simultaneously. In addition, the network methodology of VERT provides a systematic way to analyze the various tasks required to accomplish a project or mission. An automated menu-driven editor is being developed to make inputs easy. The VERT is being down-sized to run on an IBM XT/AT or compatibles with 640K memory. An 8087 math coprocessor is recommended.

The U.S. Army Logistics Management College (ALMC), at Fort Lee, Va., provides training on VERT in two courses. These are the Decision Risk Analysis Course (DRAC) and the Decision Risk Analysis for Logisticians (DRALOG) course. Further information can be obtained by calling ALMC commercial (804) 734-2027 or Autovon 687-2027.

The *Document Keyword Search (DOKS)* module represents the first phase of the Document Configuration and Control (DOCC) module development. The DOKS provides the capability to index text files and search multiple files based on user selectable key words.

Future development will expand DOKS into a capability that will, in conjunction with the APPDM

module, assist with maintaining consistency and configuration control of a program's documentation requirements. Initially the module will address the basic program planning documents that are developed in APPDM. The module will also provide a capability to assess the extent and cost of updating these documents based on changes made, or proposed, to an acquisition program.

The basic DOKS module is under development and will operate on an IBM-PC/XT/AT, Zenith Z-248, and compatibles.

The *Parametric Cost Estimating Relationships (PACER)* module provides for collecting and documenting Cost Estimating Relationships (CERs) and Cost Factors (CF) to assist in the defense materiel systems life-cycle cost estimating process. It is intended that this module shall be used as an element of the Parametric Cost Estimating (PACE) module, and the Defense Systems Management College Program Manager's Support System (PMSS). This module runs on an IBM-PC/XT or a true compatible, or a Zenith Z-120.

Small Contract Cost Performance System (SCCPS) is a modification to the CAPPS module designed to accommodate less than major programs and service contract data. It was developed by the White Sands Missile Range and is tailored to meet their needs. Future development will include some modifications and integration into the CAPPS module.

Test Issues Management Evaluation (TIME) module is an expert system being developed under funding of the U.S. Army. This module will assist the manager in identifying and developing the test issues and criteria for a weapons systems program.

A prototype has been developed and is in testing at eight Army activities. The prototype module development is scheduled for completion in FY 89.

The Integrated PMSS

The Integrated PMSS is an automated, interactive decision support system designed for use on a day-to-day basis. It operates on a data base of program information which may be derived from a program's MIS or from direct entry through PMSS.

The PMSS operates on this data to permit the user to ask "What if....?" and "Should I....?" questions, and to generate alternative courses of action for consideration. By integrating the results with external influences imposed upon the program, and by applying experience, judgment, and intuition, the user will be able to evaluate the available alternatives and, ultimately, make better and more timely decisions.

The basic concept of the PMSS is the integration of information from all of a program's functional areas. Various primary PMSS functions allow the user to use and manipulate this integrated information to solve program problems.

The PMSS contains seven components. These are Executive Support, Program Overview, Program Impact Advisor, Functions, Category, Modules, and Utilities. The Executive Support contains a calendar, telephone and address lists, action item status, and travel status.

The Program Overview component is designed to allow the user to obtain an overall program status report, assess key program areas, and evaluate potential problem areas. The user is presented with a matrix of arrows showing the status of the program functional areas (the six PMO information categories) versus cost, schedule and performance. The user may then directly access the program data that are causing any problems.

The Program Impact Advisor provides the capability to change a program schedule and/or funding and, through an expert system, obtain an analysis of the impacts those changes have on the overall program. In addition, modifications to the program are recommended for the user's consideration.

The Functions component contains a number of functional capabilities that are used to create or modify program information. The functional areas currently supported include work breakdown structure, PERT networks and critical path display, budget planning and preparation, program evaluation, budget tracking and execution, Gantt milestones, and report generation.

Category gives the user access to the program data via six information categories and the data base's hierarchical structure. The Modules component provides the capability to directly access PMSS standalone modules and user installed commercial software packages. Finally, the Utilities component includes both system administration and program management utilities such as setting user access, screen colors, data backup, etc.

The Integrated PMSS is designed to operate on a Zenith Z-248 or compatible with a 40MB hard disk and EGA Graphics. Alpha Test Version 1.00 has been delivered and is undergoing test and evaluation at selected program management office sites.

Software Distribution Policy

The purpose of the DSMC Software Distribution Center is to collect, catalog and distribute all software modules developed by the DSS Directorate and other organizational elements of DSMC.

The Software Distribution Center provides software modules to be used in the classrooms at DSMC and to program management offices (PMOs). The software is intended to help plan, program, execute and monitor defense weapon systems programs. The PMOs, to which the software is targeted, are those in the DOD acquisition community. However, any government agency that can demonstrate a valid need for this software can receive copies. Requests should be sent to:

Defense Systems Management College
ATTN: DRI-S (Software Distribution Center)
Fort Belvoir, VA 22060-5426
(703) 780-1850; AV 354-5783

The DSMC Software Distribution Center provides an update report to keep users and potential users informed about new software modules, new versions of existing modules and any changes or announcements of interest. If you are interested in receiving these updates, please contact the address listed above.

FACT SHEET PROGRAM MANAGER'S NOTEBOOK

DEFENSE SYSTEMS MANAGEMENT COLLEGE

Author: DSMC, Technical Management Department

Number: 9.6

Version: Original

Date: January 1989

I. TITLE

Environmental Policy

II. REFERENCES

—Executive Order 12088, "Federal Compliance with Pollution Control Standards"

—DODD 6050.1, "Environmental Effects in the United States of DOD Actions"

—DODD 6050.7, "Environmental Effects Abroad of Major Department of Defense Actions"

—AR-200-2, "Environmental Quality: Effects of Army Actions"

—AFR 19 (-1 thru -14), "Air Force Environmental Regulation"

—OPNAVINST 5090.1, "Environmental and Natural Resources Protection Manual"

—DLAR 1000.22, "Environmental Considerations in Defense Logistic Agency Actions"

—40 CFR 1500-15008, "Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act of 1969"

—"The Warrior and the Druid," *Program Manager*, January-February 1986

III. POINTS OF CONTACT

Deputy Assistant Secretary of Defense (Environment)
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The Pentagon
Washington, D.C. 20301-8000
(202) 695-7802

Deputy Assistant Secretary of the Army for Environment, Safety, and Occupational Health
Room 2E577
The Pentagon
Washington, D.C. 2031"
(202) 695-7824

Deputy Director for Environment/ Health and Safety
Office of the Director, Installations and Facilities

Assistant Secretary of the Navy (Shipbuilding and Logistics)
218 Crystal Plaza 5
Arlington, VA 22202
(703) 692-2259

Deputy Assistant Secretary of the Air Force (Installations, Environment, and Safety)
Room 4C940
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Washington, D.C. 20310
(202) 695-3592

IV. PURPOSE AND SCOPE

This fact sheet is designed to:

—Provide guidance on compliance with environmental protection laws, regulations and directives

—Provide primary source of information for obtaining clarification and assistance

—Define the role of acquisition program offices in environmental compliance

—Relate the procedural requirements of the National Environmental Policy Act to phases within a program life cycle.

V. POLICY

It is duty of all program managers to manage the activities assigned to them in a manner that contributes to the best possible national defense. It is the stated policy of the American people, codified in law by the Congress and upheld by the courts that we shall no longer damage the environment. These principles are not in conflict. Consideration of the environment is not just a legal requirement. It makes good military sense, it is cost effective, and it is an essential element of any successful acquisition program.

It may seem a contradiction to think of weapon systems as not being harmful. Weapons are by definition, harmful—at the receiving end. The success of a weapon system is measured by its destructive power. It is inevitable that the materials and processes used to make weapons can, themselves, be harmful. It is a fact that almost every man-made item of any kind contributes in some way to the destruction of the environment and we now know that even the most insignificant disruptions to the natural world can have catastrophic effects on the human population. As the proponent of the largest industry in the world, the U.S. military is responsible for a wide-reaching interface with the environment. The fundamental mission to defend extends to the defense of the environment as well.

The President has reinforced the law and precluded any exemption by issuance of an Executive Order requiring all government agencies, including the Department of Defense and all military services to comply with national, state and local environmental laws and regulations.

Then Secretary of Defense Frank C. Carlucci directed the military to exceed requirements in the conduct of its operations and acquisitions. Secretary Carlucci expanded a policy initiated by his predecessors and clearly stated, "We consistently need to integrate mission and environmental concerns at the earliest planning stages of projects and programs."

Compliance with environmental laws is as important as compliance with financial management, procurement, personnel and any rules regulating the conduct of government business and the behavior of civilian and military personnel. Failure to comply can bring unexpected and unnecessary costs, delays and exposure to enemy threats. Individuals responsible for non-compliance can be held personally accountable, charged with criminal violations, and subject to lawsuits by injured parties and public interest groups.

Environmental protection is now an integral part of American military policy.

In recent years, the proliferation of laws, rules and regulations governing every aspect of business and commerce has had a steadily increasing effect on the complexity and difficulty of efficiently carrying out the task of weapon systems procurement. The officer and manager that is successful and gets promoted to a position of authority and responsibility in managing a program is one who knows how to deal with the bureaucracy that comes with any set of rules. Rules are not allowed to become an encumbrance to projects. Such leaders tend to be independent thinkers and creative. They focus on results and are objective-oriented individuals who know how to get things done.

At the same time, these same individuals tend to be responsible citizens in their private lives. As such, they are environmentally conscious, often participate in community service organizations and have a genuine commitment to making their community a better place to live. Having grown up professionally in the fishbowl of the government procurement and accounting system, they are scrupulously honest and do not bring their private motives and interests into the workplace. When environmental concern is under appreciated and not thought of as a required element of the assigned task and objective, it becomes an individual's personal values that are left at home. The results have been catastrophic to careers, individuals and the public.

Caring for the environment is not just a rule to comply with because of public pressure or some legal requirement. Evidence and history show clearly that it makes good military sense. No officer would intentionally harm his/her troops. It follows that harm to the supply lines is equally counterproductive to the attainment of a military objective. By damaging our food supply, harming the health of our citizens, wasting our mineral

resources and squandering our industrial capacity, the damage we have already done to our environment has severely eroded our national capacity for defense. Future military leaders will reverse this dangerous trend, starting with the acquisition process at its inception.

A fundamental element of environmental law is that *the proponent is responsible for the life cycle of a potentially harmful substance*. As the leader and manager of an acquisition program, the program manager has the ultimate responsibility for environmental compliance by all members of his/her organization, support services enlisted, and contractors hired. He/she is perpetually accountable for any harm resulting from materials that his/her program caused to be created or moved.

There are several distinct programs aimed at curbing environmental pollution. The three principal laws directed at controlling pollution of the air, water and land as individual environmental media are, respectively, the Clean Air Act (CAA), the Clean Water Act (CWA), and the Resource Conservation and Recovery Act (RCRA). These laws deal with the conduct of activities and specify what may or may not be done, what is hazardous, and sets limits. They must be taken into account as part of the planning process because the final product of an acquisition program, as well as the manufacturing activities needed to produce that product must comply.

Executive Order 12088 directs all Federal Agencies to comply with these and all other pollution control standards. It further directs Federal Agencies to comply with any state and local standards or foreign government requirements that are applicable at their respective locations.

The law allowing the public to participate in, but not control, the decision-making process is the National Environmental Policy Act (NEPA). It is this law the program manager must be personally knowledgeable of and prepared to administer the requirements. The NEPA contains extensive reporting, analysis, publication and review requirements that are activated at the inception of a program. It is essential information for the manager of any program and students are encouraged to read and become familiar with all NEPA requirements.

VI. TYPES OF ENVIRONMENTAL LAWS

Most environmental protection laws are substantive in nature; that is, they forbid specific acts, require specific actions and set fines and penalties based on violations. These laws are the responsibility of users of equipment, materials and facilities. Compliance with them is generally the responsibility of the installation commanders or operational personnel. Developmental and acquisition programs have a responsibility to provide materiel and equipment that is free of environmentally related problems.

The NEPA is a procedural law. It permits public input into planning acquisition programs and requires specific documentation of manager's consideration of the impact that his/her program will have on local, national and global environment. Compliance with this law, and regulations and directives associated with it, is the responsibility of the program manager.

VII. OBJECTIVES OF THE DOD ENVIRONMENTAL PROGRAM

The *ultimate objective of environmental* policy is to avoid harm resulting from disturbing the natural environment. Note: This objective is not in conflict with the overall objective to develop and deploy the best possible equipment.

VIII. COMPLIANCE WITH SUBSTANTIVE LAWS

Program managers must furnish installation commanders sufficient resources to meet antipollution laws at program sites on military installations. It is also good practice for the program manager or a designated subordinate to be thoroughly familiar with the requirements of such laws as the Clean Water Act, Clean Air Act, etc., to be able to plan for the impact the program will have on host installations, user sites, and contractor's manufacturing facilities. These laws can have significant impact on cost and schedule and should be taken into account in the specification and statement of work. Training programs are available within all Services and should be attended at an early stage of any program.

IX. PROGRAM MANAGERS ROLE

The program manager (PM) is the designated proponent of military acquisitions. This position is the force causing a new weapons system to be investigated, approved, funded, developed, manufactured and deployed. Without this focal point of activity, the program and its component parts, including any hazardous materials that were created, removed from their natural confinement, or manufactured, would not exist. It is, therefore, the PM's responsibility to ensure full compliance with the law is achieved by all the diverse components and contributing elements of a systems acquisition program.

There are resources available to the PM. It is essential that management can identify skills and resources needed to carry out the requirements of the extensive national and local regulations. It should be expected, however, that the availability of those resources will be severely limited. Environmental laws are quite new, most have been implemented during the last 20 years. This has provided little time to train specialty personnel needed for dealing with the complex legal and technical problems. Furthermore, the need for regulations has been questioned, causing the postponement of training and staffing. Resistance to compliance for short-term economic reasons by industry and military programs faced with reduced budgets and personnel ceilings has further exacerbated the problem. Part of the early planning for any program should include environmental training for elements of his/her staff that will be assigned to address environmental considerations.

Environmental law and technology have spawned a new and rapidly growing industry that can be contracted to carry out a great deal of the routine tasks, administrative and functional. Because the industry is new, there has been little time for specific companies to establish reputations. The PM has an obligation to know and understand the environmental requirements of his/her program and have sufficient knowledge of the disciplines involved if he/she is going to be capable of making sound judgments when approving specifications and Statements of Work (SOWs) or when selecting a qualified contractor.

Systems acquisition activities should anticipate little assistance other than guidance and directive instructions to be provided by other DOD or HQ staffs. It is a common misconception that these organizations are charged with the responsibility by the military with environmental laws. They are not. The PM is responsible for compliance by all activities under his/her control and for cooperating and providing resources to the installation commander at the location where any programatic activity is taking place. Most of the environmental specialists with whom you will interface from outside your organization will be concerned with enforcement. It will be almost unavoidable that an adversarial relationship will exist.

It has been clearly established by the courts that the government holds the ultimate responsibility for environmental compliance by government-owned facilities, even if they are operated by a contractor (GOCO). The law is less clear in the case of contractor furnished material that is produced in privately owned facilities totally under the control of the contractor. To be sure, the contractor is responsible for compliance at his/her facility. The public, however, will hold the military responsible as well if it is a military product that caused the problem. And it becomes a military problem when a contractor facility is shut down for non-compliance or gets into financial difficulty because of unanticipated cost associated with retroactive reporting, fines or cleanup. It is essential that environmental requirements are an integral part of every specification, every contract and every sub-contract. Long after a program is completed, the supplier may no longer exist as a company when the evidence of environmental damage begins to manifest itself. There is no doubt that the burden of cleanup, restoration, and compensation will fall on the organization that caused the material to be made in the first place. The proponent can share, but cannot delegate away responsibility for compliance with environmental law.

The PM holds a special responsibility because of the scope of his/her program and the far-reaching effects that the finished product may produce. As a tenant, the PM is responsible to the installation commander at any location where work is being done. The finished product will almost certainly

have an effect on numerous installations. In addition, the PM is the only authority that can answer questions regarding the impact of his/her project on a national or global scale. In addition to making certain that the program itself is in compliance with the law, the PM must ensure that all his/her host locations are in compliance, all contractor suppliers are meeting their requirements, and the end-products are used in a manner for which they were intended at all their subsequent locations. This includes manufacturing, transportation, storage and, ultimately, disposal. It is a complex task that can only be managed with a comprehensive plan from the beginning.

X. POLITICAL CONSIDERATION

Until very recently, the concept of risk assessment was a scientific issue. The risks associated with any undertaking were weighed against the benefit of that undertaking to society and, when found acceptable, the project proceeded for the good of the whole. This is no longer the case. Risk assessment is now a political issue. The political authorities and the public chose to make the decisions on safety versus value of any program undertaken by the government or private industry. This is reflected in our basic system of laws, whereby the rights of the individual supersede the rights of the state. What this means to the PM is that, baring an imminent threat to national security and the safety of the individual, the probability of harm must approach zero.

The primary mechanism for the public to become involved in the decision-making process for any government activity is the National Environmental Policy Act. The process for compliance with NEPA is discussed in detail in Chapter 8. Failure to properly obtain public input can result in the loss of control by the PM as the public or special interest groups begin to use litigation to dictate the content and direction that programs are to take. When an ongoing program has failed to comply with the evaluation and reporting requirements of NEPA or failed to fully inform the public of every possible consequence of the program's implementation, the lawsuit that may follow will open up the program to the legal system and permit public control by outside sources that would otherwise not be possible.

It is particularly important to be thorough at the onset of any program, in the planning, evaluation, and funding stages. Technically, this importance rests in the need to be aware of, prepared to deal with, and prevent any possible harmful effects of the program. Politically, this is the best time to muster the necessary support derived from positive public opinion. It is at this stage that the competitors for a share of the program are outspoken in their support. If the PM has properly conducted the environmental assessment, made correct determinations on the need for further study, consulted with and obtained the consensus of local and regional authorities (at this point under pressure to procure the program for economic and other reasons) and properly documented the effort to consider the environmental impact of the program, it will be very difficult for opposing and hostile groups to find a legal basis to reopen the discussion or to halt the program.

When the location and scope of a program have been decided, the breadth of support begins to diminish. Special interest that supported the program for parochial reasons, both winners and losers, will begin to focus their attention elsewhere. It is at this point that the Environmental Impact Statement (EIS), if required, must be developed, circulated, and filed. The PM begins to deal with local enforcement authorities. The installation commanders become involved and take on a share of the responsibility. The EIS gives the opposition the details it needs to attack specific elements of a program and this will occur at the same time that significant outside support is beginning to fade.

One of the biggest tasks that PMs will face is one of image. They should expect environmental concern to be a dominate political priority for the foreseeable future. As with financial matters, the appearance of wrongdoing can be just as detrimental as an illegal act. Environmental matters are subject to public scrutiny at a very emotional level. As such, logic is not always going to prevail. It is vitally important that all concerned parties feel they had a fair opportunity to be heard and their needs were addressed from the onset of the program. Successful programs are going to be the ones that have clearly demonstrated that mission effectiveness is achieved without harm to the environment. Programs that win approval first will

be those making environmental protection a top priority and clearly illustrate and publicize that fact in all funding requests, progress reports and compliance documentation.

The task need not be difficult. This country has the resources available to do it. The personnel charged with managing our national defense have the necessary personal commitment to it. There is top-level direction and political support. There is a national mandate for security and a clean environment. The only element missing is a corporate commitment and a universal understanding that compliance with environmental law is an essential component of any and all military programs.